Doctoral Dissertation

Telemedicine and Teledermatology in China: History and Reality

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If you can finish one job seriously,

you will be able to understand 43% of the World.

--I was told in a dream in 1984

Telemedicine and Teledermatology in China: History and Reality

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Summary

By systematically reviewing the literature, searching at search engine Yahoo China, and using the unpublished data, we analyzed the data relevant to telemedicine and teledermatology in China.

Telemedicine emerged in China in about 1986 in the 20th century. Since then, its evolution experienced three overlapping stages:

1. Demonstration stage (from 1986 to 1994), there were only individual teleconsultations, mainly for technological demonstration. There were no academic publications in teleconsultation and telemedicine.

2. Rapid implementation stage (from 1995 to 2001), during which Chinese government attached great importance in informatization in healthcare and in telemedicine, and formulated regulations in telemedicine to standardize the practice of teleconsultation. China began to implement commercial telemedicine projects in large scale. Most commercial telemedicine projects in literature were launched in this stage. Academic publications in teleconsultation and telemedicine increased quickly.

3. Fluctuating stage (from 2002 until now), during which there were still new projects initiated, but much less than in the second stage. Academic publications in teleconsultation and telemedicine dropped from its peak in 2001 to its valley in 2005. They were increasing again since then, but there is still a fluctuating trend. The year-after-year quantitative changing trends in Chinese publications and English publications in teleconsultation and telemedicine are similar. Only the changes happen a few years later.

It is generally thought telemedicine can benefit patients, doctors, hospitals, and society in general, because it can meet the needs in China: providing the patients with services that are better in quality, faster in speed, cheaper in costs, and more convenient without travel; increasing the fame of the consultant doctors and hospitals; sharing medical resources; and improving the consulting doctors' expertise and consulting hospitals' competitiveness. Furthermore, telemedicine can also play a role in collaborative research.

However, in implementing telemedicine, China also encountered some problems: The regulations lacks of detailed integrated standards; lacking of experiences in organization and administration; no valid cost-effectiveness analyses; Patients knew less about

teleconsultation and were not confident about it; and doctors doubted its effect and worried about they would lose face and the possible medical deputes if the invited specialist had different opinions with him. We found teleconsultation stations in general can not be economically sustained, which may be the main sticker for the implementation of telemedicine in China. Besides, teleconsultation has been had its own limitations.

Nevertheless, the existing problems in telemedicine in China have been noticed and solutions to the problems have been proposed by many authors. The introduction of new technology from abroad and development of innovative products at domestic have never been stopped. These new technologies and products will facilitate telemedicine to provide service with better quality; and telemedicine will become more secure, more affordable, and more convenient. At the same time, we can also anticipate the potential competition and conflicts of interest in the future due to the new products. The future of teleconsultation in China will become an integrated part in hospital information system and e-health system. However, it is not possible to predict when this implementation will take place, how furious the competition during the implementing process will be, and how great the risks will be imposed on the teleconsultation providers.

Concerning teledermatology in China, although in projects in general telemedicine and telepathology, teleconsultations in dermatology were also undertaken, the relative frequency of teleconsultation in dermatology was only 2.43% in average, and the number of teleconsultation in dermatology per hospital per month was only 0.01. In addition, special commercial teledermatology projects are still lacking. In the recent years, some professional dermatological societies, departments of dermatology, companies founded websites in dermatology, but they only provide non-profit information service and online books and atlas for education purpose. On several websites free forums also were founded, either for patient-to-doctor consulting, or for doctor-to-doctor exchanging.

The Department of Dermatology, Medical University of Graz, Austria began cooperation with China in teledermatology from 2000. The cooperation between Graz and Zhengzhou has a nature of academic exchanging and research. The cooperation between Graz and Wenzhou seems having a commercial perspective. Implementing teleconsultation cross border between different countries, special potential problems due to various differences of the involved countries in etiology and manifestation of skin diseases, patient's expectation and responses to treatment, culture background, economic statue, and medical systems should be addressed. Potential conflict of interests with local dermatologists and the governmental policy about the licensure of foreign doctors to practice teleconsultation in China should be paid attentions to.

One project of this collaboration is a study in dermoscopy of genital warts in male. In this study, dermoscopic structures of 42 lesions from 37 male patients with genital warts were identified and defined. Relative frequencies of dermoscopic structures in the 42 lesions were the main outcome measures. Teledermatology was used for second opinion in dermatopathologically controversial lesions and for further evaluation of dermoscopic structures of all the 42 lesions. Our results show that the main dermoscopic features of genital warts were exophytic papillary structures and vascular structures. The exophytic papillary structures were composed of tightly arranged papillary units, which were usually equal in diameter, but may be either similar or different in length. Most vascular structures were located in the center of each papillary unit. In addition, there were variation and special characteristics in all the four clinical subtypes of genital warts, i.e.

flat warts, smooth popular warts, classic pointed warts, and keratotic warts. In conclusion of this study, dermoscopy of genital warts is useful in the diagnosis of flat warts, and in the differential diagnosis of genital warts from seborrheic keratosis or lichen planus. Further researches in dermoscopy of Bowenoid papulosis, condylomata lata and erythroplasia of Queyrat are indicated, in order to find the possibility of differentiating genital warts from these diseases dermoscopically.

Keywords: telemedicine; remote consultation; teledermatology; China; dermoscopy; condylomata acuminata; seborrheic keratosis; lichen planus; Bowenoid papulosis; condylomata lata; erythroplasia of Queyrat.

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Then, I would like to thank **Prof. H. Peter Soyer**.
It's him to inspire me to go into two pioneering professional fields: teledermatology and dermoscopy, which are full of challenges and excitements. Without his encouragement, I am almost not able to go on in the fields until now. I got lots of help from him in most researches of mine in teledermatology, although he has been encouraging me to become an independent researcher. Furthermore, I am also very grateful for his conscious and unconscious helping in improving my professional expertise, independent research capability, as well as even my English and interpersonal skills with people from different cultures. I just have to admit that he has been having a quite positive influence on me since I got to know him since 1999.

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Contents

PART ONE

Telemedicine and Teledermatology in China: History and Reality

1 Introduction

Teledermatology is defined broadly as utilization of modern digital and telecommunication technologies to delivery teleconsultation, teleeducation, and information service in dermatology at a distance, usually from dermatological centers of excellence to primary care hospitals or remote areas, where lack of resource exists. Its targeted users can be both patients and professionals. [1-4] It is an application of telemedicine in dermatology among other medical disciplines. [2-4] Teledermatopathology, [5, 6] and teledermatoscopy [7] are two specific fields in teledermatology. Due to its visual nature, dermatology can fit telemedicine application quite well. [1, 8] In many cases, teledermatology is only referred to teleconsultation in dermatology. [1, 3, 4] It is expected to be a solution for lack of dermatologic resource in rural areas in America, [4] for increasing demands in dermatologic service in United Kingdom, [3], and for avoidance of expense and inconvenience of long-distance travel in patients with chronic leg ulcers to visit specialists in Austria. [9] Colleagues in United Kingdom, America, and Spain demonstrated the potential benefit of teledermatology in outpatient triage or biopsy triage in patients with pigmented skin lesions or skin cancers. [10-12].

As telemedicine, teledermatology can be practiced with either synchronic real-time videoconference modality or asynchronous store-and-forward (SAF) modality. [1-3] In real-time teledermatology, a videoconference unit and a video camera mounted on the unit with proper telecommunication approach enable patient and telepresenter (nurse, general practitioner, or inexperienced dermatologist) to see and communicate with a specialist. [3] Specialist can obtain patient's further information and feedback, and patient can receive specialist's advice immediately during teleconsultation. [2, 3] However, because three parties involved in this modality must be present at same time, it is difficult to schedule and organize; and therefore real-time teledermatology is more time consuming and not flexible. [2, 3] This will be particularly true when international teleconsultations are undertaken between countries with great time difference. Furthermore, real-time teledermatology needs higher bandwidth for data transmission. Both equipment and infrastructure are expensive and not portable. [2]

In contrary, in store-and-forward teledermatology, patient's medical record and still image(s) are sent via e-mail or web-based teledermatology application to specialist. Specialist can answer the request at his or her convenience, or before a scheduled deadline. [13, 14] The still images can be taken with low-cost digital camera, photo cell phone, or personal digital assistant. The bandwidth requirement is lower. [2, 3] Hence, store-and-forward teledermatology is more affordable and flexible. However, if a robot microscope or virtual slides are used for teledermatopathology, store-and-forward modality can also be expensive and not portable [15, 16]; whereas if personal computer based videoconference takes the place of old-fashioned videoconference system, real-

time teleconsultation will also be as cheap and convenient as store-and-forward technique. [17]

In the recent years, there has been an increased interest in teledermatology, [1, 3] due to decreased costs and improved quality of teleconsultation systems, and growing acceptance from patients and dermatologists. [3] Our search results with formula "(teledermatology) OR (teleconsultation AND dermatology) OR (teledermatopathology) OR (telepathology AND skin disease) OR (teledermoscopy)" in PubMed on Feburary 21, 2008 showed that total 316 papers have been published in the field of teledermatology. The first paper was published in 1994. Since then the number of publications in teledermatology experienced a rapid increasing stage until 2000, followed by a slight reducing trend with mild fluctuation from 2000 to 2007. The largest annual frequency 35 was found both in 2000 and 2003. The publications in teledermatology reflect the finished or ongoing projects in teledermatology worldwide, either in research or in practice, including online dermatological information resource building, [18, 19] teleeducation, [20-22] and teleconsultation. [14, 23]

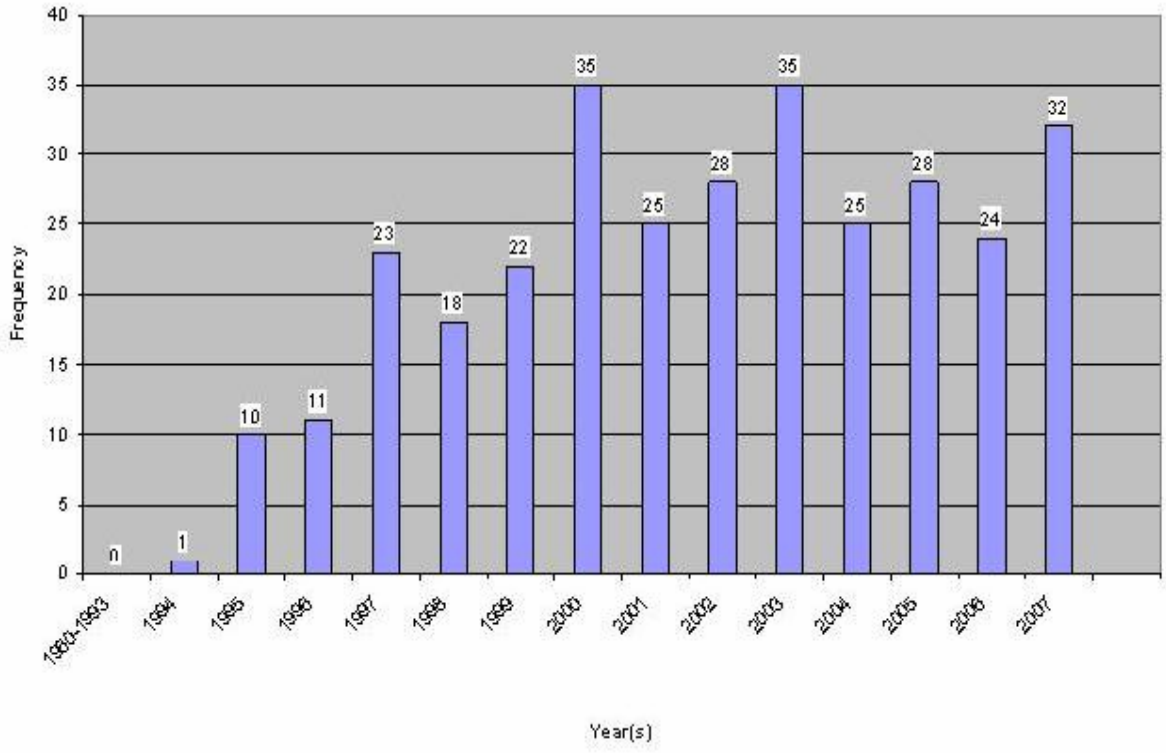


Figure 1. Annual frequencies of publications in teledermatology in PubMed from 1960 to 2007.

China is a large developing country with about 1.3 billions population. [24] Statistical data in 2005 by Chinese Ministry of Health indicate that there are only 14 088 dermatologists in whole China. [25] China's great sustainable economic growth in recent years even amazed the wealthy western world. [26] However, searching main English databanks in medical literature PubMed, EMBASE, and Cochrane Library, we found hardly information concerning teledermatology in China.

In this dissertation we mainly aimed at reviewing Chinese teledermatology, including own works, in order to unveil its history and reality, in which certain decision makers in teledermatology may be interested. As teledermatology is possible to be practiced in

general telemedicine and telepathology, we reviewed these fields of telemedicine as well, focusing on teleconsultation.

In addition, we reported one our recent research projects in dermoscopy to present an example of a teledermotologic study between China and Austria.

2 Methods

Searching Chinese databank Chinese National Knowledge Infrastructure (CNKI), as well as English databanks PubMed, EMBASE, and Cochrane Library with formula "(telemedicine NO tele-medical-education) OR (teleconsultation NO tele-medical-education) OR (telepathology NO tele-medical-education) OR (teledermatology) OR (dermatology AND teleconsultation) OR (teledermatopathology) OR (teledermoscopy)," we found 920 papers. Search PubMed, EMBASE, and Cochrane Library with formula "(telemedicine AND China) OR (teleconsultation AND China) OR (teledermatology AND China) OR (teledermatopathology AND China) OR (teledermoscopy AND China)," We found 51, 10, and 0 papers, respectively.

Our enrolling criteria for literatures are publications relevant to teleconsultation in general medicine, pathology, and teledermatology in China. By screening titles and abstracts of the search results, we excluded papers of the following categories: reviews relevant only to events in foreign countries; telemedicine product introduction and development; relevant to only other medical disciplines, other than dermatology; duplicated papers of the same authors; papers of different authors but with similar contents. Then, 186 full-text papers were analyzed and the following outcomes were identified: Chinese policy and regulation in telemedicine and teledermatology; need of teleconsultation in China; history aspects and events; main projects of teleconsultation in general medicine, in pathology, and in dermatology; benefit of teleconsultation; problems and limitations; suggestions and perspectives.

After identifying the aforementioned outcomes, we searched again the databanks with the primary outcomes as keywords again and select other relevant words and / or phrases as keywords if necessary, in order to find more detailed information about the primary outcomes. For example, we searched with a certain project name to find the following outcomes: Entity implementing the project; initiating date; teleconsultation system and telecommunication approach applied; number of teleconsultation stations founded; number of teleconsultations undertaken; current statue. We calculated total number of teleconsultation stations and total number of teleconsultations, and average teleconsultations per hospital per year.

We also identified all the papers with statistics in numbers of teleconsultation in different medical disciplines. We classified the teleconsultations in the original publications into three categories: in dermatology; in non-dermatology, by which we meant the non-dermatological disciplines stated clearly in original publications; in others, by which we meant the disciplines categorized as others or not stated in original publications. Then, we calculated the frequency of teleconsultation in dermatology among general medicine and pathology, and the number of teleconsultation per month per hospital as main outcomes.

Finally 218 full-text papers were investigated. When there were lots of papers speaking about the same topic, we referred to the five most important papers.

Considering websites in dermatology are also related to teledermatology, we also identified the dermatological websites, which were published in academic papers, and included those we knew, but which have not yet been published, as well. Then, by browsing the websites, we found information relevant to teledermatology for review.

Furthermore, when certain information in literatures was not given in detail or lack, we tried to find relevant information with search engine Yahoo China.

We included our own works in teledermatology, which have not been reported.

We also searched CNKI and PubMed with keywords “teleconsultation” and “telemedicine”, for annual number of publications in teleconsultation and telemedicine from the two databanks from 1960 to 2008. As there were only a few publications yearly during 1960 and 1990, we didn’t try to get the number of publications in each year, but we obtained the numbers of publications in 10 years’ interval. We calculated the total number of publications in teleconsultation and telemedicine in CNKI and PubMed, ratio of numbers of publication in telemedicine in CNKI and PubMed, and ratio of numbers of publication in teleconsultation in CNKI and PubMed.

Finally, we included a few papers in new telemedicine products introduction from abroad and development at domestic as examples.

3 Results

3.1 Need of Teleconsultation in China

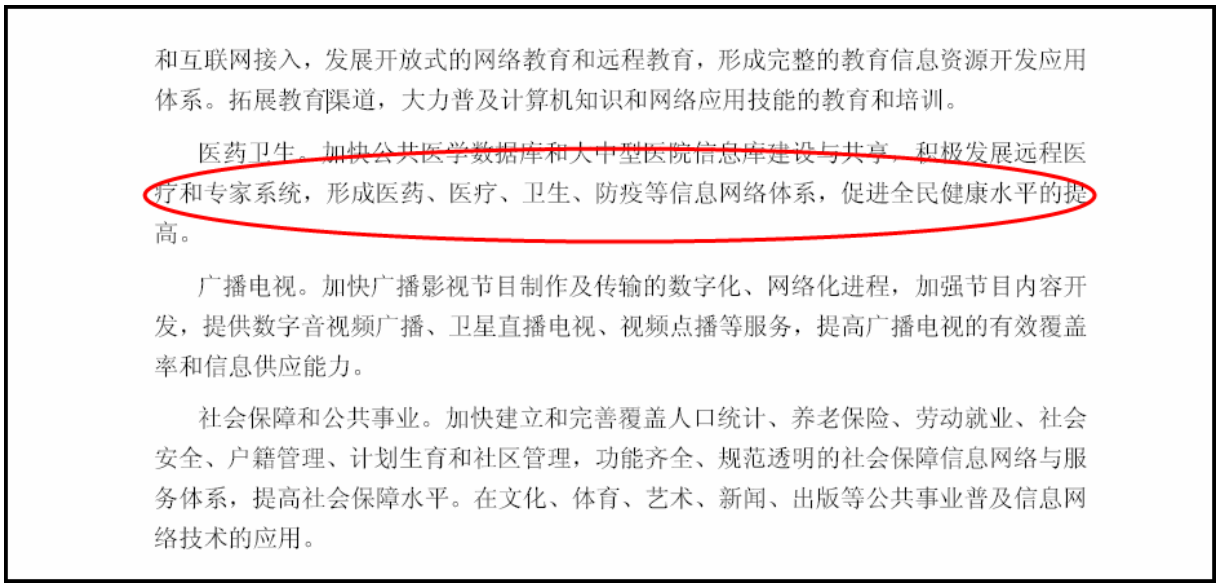
China is a large developing country with unevenly distributed medical resources. [27-30] 80% medical institutions are located in cities; whereas 20% medical institutions are situated in rural areas, where 80% populations live. [28] Tertiary hospitals are basically located in large or media-sized cities, equipped with most of experienced specialists, and state-of-art medical instruments and infrastructures. [27-30] At the same time, the resources in the primary hospitals in rural areas and communities in cities are rather humble. [27-30] They lack of capability in diagnosis and management of severe and unusual diseases [28]. Consequently, they are usually not trusted by the patients. [30] So, it is rational that patients in cities prefer to visit tertiary hospitals as the first line choice, even for usual, mild, and chronic diseases. [30] However, patients with severe or unusual diseases in rural areas have to be transferred to tertiary hospitals in large and medium cities, which means long-distance travel, time-consuming, cost-increasing, and delayed management of the diseases. When they arrive in tertiary hospitals, there usually are long waiting lists. [27] Therefore, teleconsultation is expected to be able to reduce costs, save time, decrease transfer of patients and possible delay of management, and to balance the patient volumes in hospitals with different medical resources. [27, 28]

Furthermore, in rural areas, one county grade city or region grade city usually has 2 or 3 hospitals. Competition in patient resource between hospitals makes them to buy additional digital medial instruments and information technology products, and to cooperate with medical authorities actively, for which teleconsultation is a convenient way. Teleconsultation between authoritative specialists of famous medical institutes and inexperienced and uncompetitive doctors in rural areas can strengthen competitive

capability of the doctors at lower position and improve their expertise. Telemedicine has potential to increase their economic income, in addition to its social effectiveness for patients. [31]

Concerning teleconsultation in dermatology, questionnaire survey of 68 dermatologists from 12 hospitals in Henan Province, China in 2002 indicates all of them have difficult cases in clinical work, which account for 1% to 30% of their total patients. [32] An analysis of skin disease spectrum in Department of Dermatology, the First Teaching Hospital, University of Zhengzhou, Zhengzhou, China shows that among all the 9880 patients seen in one year by two dermatologist in the out-patient clinic, non-specific diagnosis were made in 291 (2.95%), and there were 27 (0.27%) patients suffered from extremely unusual skin diseases and even non-specific diagnosis were not be able to be rendered, which were not able to be grouped into any established categories of skin diseases by colleagues in the department. [33] These difficult or unusual cases, along with the cases diagnosed as unspecific dermatitis reflect the demand of a solution, and they may be indications for teleconsultation. [32, 33]

3.2 National Policies on Informatization and Telemedicine Development



和互联网接入，发展开放式的网络教育和远程教育，形成完整的教育信息资源开发应用体系。拓展教育渠道，大力普及计算机知识和网络应用技能的教育和培训。

医药卫生。加快公共医学数据库和大中型医院信息库建设与共享，积极发展远程医疗和专家系统，形成医药、医疗、卫生、防疫等信息网络体系，促进全民健康水平的提高。

广播电视。加快广播影视节目制作及传输的数字化、网络化进程，加强节目内容开发，提供数字音视频广播、卫星直播电视、视频点播等服务，提高广播电视的有效覆盖率和信息供应能力。

社会保障和公共事业。加快建立和完善覆盖人口统计、养老保险、劳动就业、社会安全、户籍管理、计划生育和社区管理，功能齐全、规范透明的社会保障信息网络与服务体系，提高社会保障水平。在文化、体育、艺术、新闻、出版等公共事业普及信息网络技术的应用。

Figure 2. Policies of the informatization development in health industry in the Special Key Plan for informatization Development under Outline of the 10th Five-Year Plan of National Economic and Social Development, People's Republic of China: "to accelerate founding and sharing of public medical databanks and information databanks of large and medium hospitals, and to actively develop telemedicine and specialist systems; so as to found information network systems in pharmacology, medicine, health, and epidemic prevention to promote improvement of people's health condition." [34]

National Development and Reform Commission (NDRC) in China is a macroeconomic management agency under State Council. It studies and formulates policies for economic and social development, maintains balance of economic aggregates, and guides the overall economic system restructuring. In 2001, Special Key Plan for Informatization Development was formulated by NDRC and approved under the Outline of the 10th Five-Year Plan of National Economic and Social Development. [34] In contrary, in the 9th and 11th five-year plans, informatization development was not mentioned. [35, 36]

In the Special Key Plan for Informatization Development, the development direction of telemedicine in the context of informatization devolpment in health industry is defined as: “to accelerate founding and sharing of public medical databanks and information databanks of large and medium hospitals, and to actively develop telemedicine and specialist systems; so as to found information network systems in pharmacology, medicine, health, and epidemic prevention to promote improvement of people’s health condition.” [34]

Basing on the above plans, Chinese Ministry of Health formulated 2003-2010 outline of National Health Informatization Development Plan, in which more detailed policies are provided. [37]

3.3 Chinese Regulations Relevant to Teledermatology [38]

Up to now, two documents have been formulated to standardize the practice of telemedicine in China. There are still no specific regulations for teledermatology in China until now.

3.3.1 Announcement on Strengthening Administration of Teleconsultation

In 1999, to guarantee the medical order, to standardize medical practice, to protect doctors and patients’ rights, to make full use of the limited medical resources, to satisfy the increasing need of people for medical services, and to enable the healthily and orderly development of telemedicine, Chinese Ministry of Health promulgated the Announcement on Strengthening Administration of Teleconsultation. Up to now, this announcement still remains the most important document in teleconsultation, in which the main regulations of teleconsultation in China were worked out. The main regulations in teleconsultation are listed below:

- Practicing telemedicine should enable the citizens in various areas to access high-quality, fast, and convenient medical counseling services, to increase the utilization of medical resources, and to be beneficial in decreasing the medical costs.
- Found demonstration project in qualified medical institutes first, and then implement telemedicine step-by–step to primary medical institutes.
- Telemedicine systems are administrated by the department of health of the respective grades. A unified standard must be utilized.
- Telemedicine belongs to medical practice, which is only permitted to be practiced in the medical institutes who have required medical licensures and can acquire images data that are clear enough. The participated technicians must be trained before they are permitted to work in the telemedicine network administration center. They can provide only technological services and are not permitted to engage in medical counseling.
- The medical institutes that have a telemedicine system should organize the consultant physicians. Only medical professionals with university professor/clinical professor or university associate professor/clinical associate professor titles are competent to utilize telemedicine to provide medical counseling services.
- According to the state of the disease, before application for a teleconsultation, the medical institute must explain the aim of teleconsultation to the patient or his/her relatives and ask for his/her/their consent. After teleconsultation the result should be documented in the patient’s medical record and reported to the patient and his/her relatives.
- The price standard of teleconsultation is constituted jointly by the provincial department of health and department of price.
- The relationship between consulting physician and referring physician belongs to the

relationship of medical counseling in medical knowledge, whereas the relationship between the referring physician and the patient belongs to the physician-patient relationship in the common legal meaning. The right making the decisions in diagnosis and management belongs to the medical institute where the patient is treated. If medical dispute happened, the referring medical institute is responsible for the medical dispute.
- The telemedicine network should be established based on the current practical situation, which can utilize various basic telecommunication infrastructures (telephone line, optic fiber, satellite network, and so on.)

3.3.2 Administrative Measures in Medicine and Health Information Services on Internet

Basing on the Administration Measures on Information Services on Internet (enacted by the Chinese Ministry of Information Industry) and health-related laws and regulations, the Administrative Measures on Medicine and Health Information Services on Internet was constituted and enacted in 2002, in which the aim of issuing this administration measures is illustrated, and the regulations on the administrative measures stated, which are not controversial to those regulations in the Announcement on Strengthening Administration of Teleconsultation. The most important regulations directly or indirectly related to telemedicine include:

- Any business or non-business medical websites or websites, at which medical information is published, must apply for licensures in the Chinese Ministry of Information Industry or its provincial department. Before the application, it should be examined, verified, and approved by the same grade of department of health. It's monitored and administrated by the department of health.
- Medical information services belong to medical counseling services. Online patient-to-doctor consultation is not permitted. As patient-to-doctor consultation belongs to medical practice to provide telemedicine service via Internet, the regulations in the Announcement on Strengthening Administration of Teleconsultation must be abided. Telemedicine can only be practiced between medical institutes that have licensures.
- The medical information provided by websites must be scientific and accurate, and its sources should be provided. When medical information related to policies of health, epidemic situation, and important medical affairs are to be published or reprinted, related laws, and regulations should be complied with. Before the advertisements of medical products are published, it should be examined, verified by the related departments and the related laws and regulations must be abided.

3.4 History and Commercial Projects of Teleconsultation in China

3.4.1 Emergence of Teleconsultation and Individual Cases

It's generally accepted that teleconsultation in China began in 1990s. In 1986, a mariner suddenly suffered from an emergent condition in a cargo ship. An efficacious rescue was not able to be undertaken because of limited medical resources in the ship. Therefore, Guangzhou Oceangoing Shipping Cooperate sent a telegraph for teleconsultation across the sea. Although the telecommunication technology used was not so advanced at that time, this consultation is thought to be the first application of teleconsultation in China. [39] In 1988, utilizing satellite telecommunication technology, the General Hospital, People's Liberation Army held a case-discussion session in neurosurgery, with participation of a hospital in Germany at distance. [28, 40] In 1993, China jointed in Arizona-International Telemedicine Network (AITN) as one of its two international sites. The network provided second opinions in surgical pathology and cytopathology cases

with store-and-forward system. The teleconsultation showed a high level of success in providing useful information to consulting pathologists. [41] In 1994, Huashan Hospital, Medical University of Shanghai had a teleconsultation demonstration with Xi'an Jiaotong University. [39]In 1995, using satellite telecommunication technology, the 541st Hospital, Commission of Science, Technology, and Industry for National Defense in Beijing undertook a remote case discussion in spinal surgery together with a hospital in America. [39] Another two events also happened in 1995, attracting the public's great attention to teleconsultation. Dr. Lee, Chinese University of Hong Kong remotely diagnosed two patients: Xiaoxia Yang with necrotic fasciitis due to mixed infection, and Ling Zhu with thallium poisoning. [42] In 1997, using integrated services digital network (ISDN), the Children's Hospital, Medical University of Shanghai undertook discussion on controversial and difficult cases with Mary Hospital, Hong Kong. [40] In 2003, the first operation in neurosurgery by remote-controlled robot was successful finished in Chinese General Navy Hospital. This operation is the most advanced telemedicine application in China, and is also the first operation by robot. [39]

3.4.2 Implementation of Commercial Teleconsultation in Large Scale

3.4.2.1 Golden Health Projects

In 1995, Center of Statistics and Information, Institute of Medical Administration, and Steering Group of Computer, Ministry of Health proposed the concept of Golden Health Project, originally with the aim to comply with the plan of national informatization development in health industry. In 1997, the goal of Golden Health Project was defined in a more specific way: developing and applying hospital information system (HIS) as a foundation; integrating payment and settlement system, and integrating teleconsultation system in hospital information system when they fitted for the local situation. Golden Health Project in military includes three different and mutually related projects. The goal of no 1 Military Project is to develop and apply web version of military hospital information system. No 2 Military Project is dedicated to found information network in medicine, pharmacology, and health; and to implement pilot teleconsultation. No 3 Military Project is aimed at founding comprehensive databank for administrative departments. [43, 44] Herein we only concentrate on the teleconsultation projects.

3.4.2.1.1 Civil Teleconsultation Projects

Project by Golden Health Medical Network Engineering Co. Ltd, Institute of Medical Administration, Ministry of Health

Utilizing satellite (no 2 Asia satellite), Golden Health founded a Ku band satellite telecommunication network particularly for teleconsultation in 1997. [40] Creative ShareVision PC 3000 was the videoconference system applied in the project; [45] Teleconsultation stations were founded in about 20 important hospitals, which were located in about 15 large cities, including Beijing, Harbin, Jiamusi, Guangzhou, Shanghai, Fuzhou, Haiko, Rongcheng, Guiyang, Xiangmen, and others. [43, 44] In news published in 1999, it was reported that 3000 teleconsultations, 1000 hours' education programs, and 10 live broadcasting of international conferences had been finished. [46] Nevertheless, the project was not able to last long. The company does not exist anymore. Zhang X critically analyzed this project. He thinks that one reason of failure is the expensive costs for both hospital and patient: Hospital needs to invest 2 000 000 CNY (1 CNY is about 0.1 EUR) for equipments, and Patient is asked for 1000 CNY for

one teleconsultation. [47] The high costs are also pointed out as a reason of failure of this project in another paper, although the data are not same as in paper by Zhang. In the latter paper it is stated that the costs of equipments for one consultation station range from 300 000 to 800 000 CNY, and patient pays for one teleconsultation 300 to 1000 CNY. Although equipments are paid by the government, the satellite telecommunication remains still a burden for the hospital. In addition, hospital has to appoint staff to administrate the station. [40]

Project by Chinese Medical Board

Entrusted by International Association of Medical Internet, and entities from domestic and abroad, Chinese Medical Board founds Chinese teleconsultation core network. Teleconsultation is undertaken with wire telephone and relevant equipments. In the publications in 1999, it was reported that teleconsultation stations were founded in about 100 hospitals. [43, 44] By April, 1999, the number of stations increased to168. 3500 specialists working in hospitals higher than provincial level were organized as consultants for teleconsultation. 1182 teleconsultations were undertaken in the first two years. [48]

The First Teaching Hospital, University of Zhengzhou (Dong H's working affiliation), had been one member of this network since 1996. The hospital founded a telemedicine center, which occupies one room with an area of about 30 m^2. Two nurses had been working there as staff members to organize teleconsultations since then. The main teleconsultation system used was a videoconference system PHILIPS (E833/P5MMX200, Production Company unknown). During that time, the telemedicine center had only connections with the telemedicine centers in the higher-up hospitals in Beijing and Shanghai and worked only as a consulting telemedicine center, i.e. the physicians in the hospital referred unusual cases to famous specialists in Beijing and Shanghai. For one teleconsultation, the patient paid 600 CNY, among which 300 CNY was paid to the telemedicine center at the distance, and the other 300 CNY was paid to the telemedicine center in consulting hospital. As no documentation was made then, no data can be found about statistics of the number of teleconsultation. Anyhow, according to the nurses working in the center, less than 100 teleconsultations were undertaken yearly at that time. From 2001 until now, a new teleconsultation system took the place of the system from the Chinese Medical Board. The teleconsultation under this project was stopped since then. [49]

Project by University of Fudan, Shanghai

Teleconsultation project of Medical College, University of Fudan, Shanghai is organized and implemented together with Shanghai Commission of Education, Shanghai Jiaotong University. Under the project, the first completely distributed and open model of teleconsultation system is developed in China. [50, 51] Its formal application began in 1995. In 1997, it began to be organized in grouped model. [52] In a publication in 1998, it was reported that 48 hospitals in Shangdong, Jiangsu, Zhejiang, Anhui, Fujian, Henan, Gansu, Jiangxi, Hunan, Xingjiang, and others had registered as the users of this teleconsultation project, and teleconsultation had been undertaken in 650 patients since October, 1995. [43] 1000 teleconsultations had been conducted later, reported in another paper published in 1999. [53]

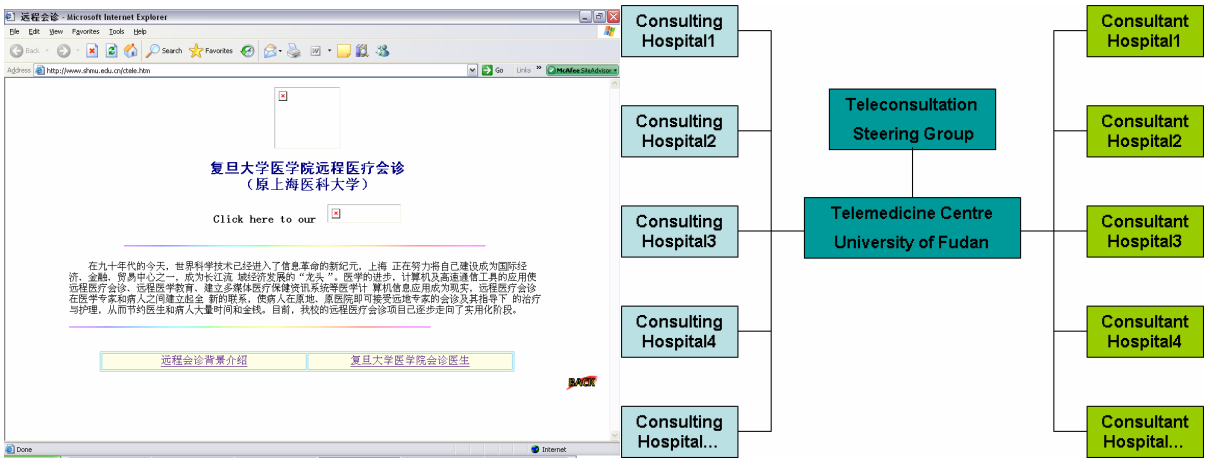


Figure 3, 4. Teleconsultation in Medical College, University of Fudan, Shanghai, China [54] and its organization. [52]

The teleconsultation service is provided by about 200 famous professors in about 20 medical disciplines from 7 affiliated hospitals and 5 teaching hospitals of Medical College, University of Fudan, and would be delivered to consulting hospitals in remote areas. A steering group, consisting of leaders of the university, vice rectors and directors, Department of Medical Administration from each consultant hospital, is organized for coordination and administration of the project. A telemedicine center is founded, which is equipped with various telecommunication infrastructures for real-time teleconsultation, including satellite (Xinnuo 1 satellite, International telecommunication satellite), digital data network (DDN), frame relay, X125, ISDN, telephone dial-up, asynchronous transfer mode (ATM), wireless access, interactive network, and others. Furthermore, a server is provided in the teleconsultation center to administer user registrations and teleconsultation requests from both domestic and abroad. After registering as a user and installing the teleconsulting system and relevant software, the consulting hospital can visit the teleconsultation system through China Education and Research Network (CERNET), China Public Information Network (CHINANET), and China Medical Information Network (CMINET). [55] The videoconference system applied is Intel Proshare. [56]

3.4.2.1.2 No 2 Military Project

No 2 Military Project is a project approved by Chinese Ministry of Health, organized and implemented by Department of Health, General Logistics Department, People's Liberation Army, China. Under the project, All-Army Telemedicine Information Network is found. [57] In 2005, the General Logistics Department authorized Beijing Junweixingchi Information Technology Co. Ltd as the sole agent to promote the application the All-Army Telemedicine Information Network. [58]

Before 2001, telephone line was utilized as the telecommunication approach; and since 2001, it was replaced by satellite telecommunication technology. [59] Videoconference system applied previously was VDO phone and Netmeeting. [60] Now All-Army Telemedicine Information Network is a multifunctional platform, founded by utilizing American LinkStar broadband satellite telecommunication system and independently-developed broadband videoconference system. The design criteria are referred to broadband VAST system. [61]

Under the project, two kinds of stations, one-direction teleeducation station and two-

direction teleconsultation are founded. One-direction teleeducation station has the functions of one-direction videoconference and news publication. It is used for one-direction teleeducation, vedioconferencing, and news publication. Equipment requirement in one-direction teleeducation station includes 1.2 M one-direction satellite antenna, DRO low-noise amplifier, and IP data receiver. Whereas two-direction teleconsultation station has more functions, including teleconsultation, interactive teleeducation, videoconferencing, information retrieval and news publication. Equipments required in two-direction teleeducation include 2.4 M two-direction satellite telecommunication antenna, BUC power amplifier, LNB low-noise amplifier, LinkStar Modem 4800, KD8005 media gateway, POLYCOM video accessory. [61]

Until the end of 2002, one web administration center, more than 230 two-direction teleconsultation stations, more than 160 one-direction teleeducation stations were founded. [62] In a publication in 2007, it was reported about 800 one and two-direction stations had been founded in tertiary hospitals in all of the large and medium cities in China, among which were General Hospital of the People's Liberation Army, General Hospital of Air force, General Hospital of Navy, General Hospital of Armed Police, and all the general and central hospitals of military regions. In addition, three mobile teleconsultation vehicles have been constructed. [61]

Figure 5, 6. Whole-Army Telemedicine Information Network and distribution of the stations of the telemedicine satellite network [57]

3.4.2.2 Project by Huashang Hospital, University of Fudan, Shanghai

In 1994, Huashang Hospital, University of Fudan, Shanghai developed videoconference teleconsultation system. In 1995, the hospital founded a teleconsultation center. By the end of 2005, the users increased to more than 100; and total teleconsultations numbered 3776. [63]. The teleconsultation center in Huanshang Hospital does not only use their own teleconsutlation system, but also use systems from other companies. [53]

3.4.2.3 Project in Xuzhou

Xuzhou project was implemented in the First People's Hospital, Xuzhou, Jiangsu Province and the surrounding area since 1995, with equipments provided by Xuzhou Anditai Medical Instruments Co. Ltd. 18 teleconsultation stations were founded in 18 township hospitals, which were located in rural areas about 100 kilometers away from Xuzhou [64].

3.4.2.4 Project by Shanghai Science & Technology Investment Co. Ltd

Shanghai Science & Technology Investment Co. Ltd began to develop teleconsultation system in 1995 and finished the development in 1996. The company founded a consultant center in Huashang Hospital, University of Fudan, Shanghai and founded about 20 consulting centers in the whole China in 1996. In the first two years, hundreds of teleconsutlation were conducted. In 1998, the company launched new teleconsultation system composed of independently-developed videoconference system with Internet-based telecommunication approach. The system has a client/server structure, which enables multi-party teleconsutlation. Anhui province signed an agreement to first found 60 teleconsultation stations, and then to increase the users to 200 in short term. [53]

3.4.2.5 Project in Hunan Province

Xiangya Hospital, Central South University, Changsha, Hunan Province programmed and implemented the Hunan project since 1997. The hospital used asymmetric digital subscriber line (ADSL) as telecommunication approach. The maximum transmission speeds of downward and upward signals were 9 Mbps and 1 Mbps, respectively. The teleconsultation system applied was AVCON videoconference system by Shanghai Huaping Computer Technology Co. Ltd. The medical images were scanned with transmission scanner, and then adjusted with Photoshop and transmitted via Internet. As a consultant hospital, Xiangya hospital had more than 90 consulting hospitals and 2000 consultations had been undertaken in patients with unusual, controversial, or severe conditions. [67]

3.4.2.6 Project in Shandong Province

The Provincial Hospital and the Telecommunication Bureau of Shangdong jointly implemented the project since 1998. They invested 2 000 000 CYN to purchase 4 Healthstation 2000 from American VTEL company. Using ATM public data network of Shangdong Administrative Bureau of Post and Telecommunication, they set up 26 accesses in 17 districts and cities in the province. About 100 consultations had been undertaken [65]. In 2007, the Provincial Hospital founded a teleconsultation center, cooperating with German Siemens Company and Shangdong Wangtong Telecommunication. Five hospitals in counties had already had access to the teleconsultation center. [66]

3.4.2.7 Project in Henan

China Unicom organized and implemented the project. [68] In 2001, The First Teaching Hospital, University of Zhengzhou, Zhengzhou founded two telemedicine centers as teleconsultation and teleeducation provider under the project, ending its history as a consulting hospital under the aforementioned teleconsultation project by Chinese Medical Board since 1996. In the telemedicine centers, the hospital installed POLYCOM (Viewstation EX H 323, Tellcom & Data Inc, Chicago, USA), television, object exhibition platform, projector, and other relevant equipments. [49, 68] In two operation halls, the hospital installed video cameras, which were connected to the telemedicine centers for operation teleeducation. Telemedicine centers for consulting were found in other hospitals under the project. Unicom China provided special line for telecommunication between the telemedicine centers. [68] By 2006, 18 consulting centers had been founded. In one telemedicine center, the First Teaching Hospital, University of

Zhengzhou, the teleconsultations were increasing from 297 patients in 2003 to 662 patients in 2005. Brief record about the activities in the center began from January, 2006. From January to May in 2006, teleconsultations amounted to 233, mainly from department of orthopaedics, department of respiratory medicine, department of radiology, and others. There were only 2 teleconsulations in dermatology. Also during this period, 12 lectures were given by the doctors in the hospital. For one teleconsultation, the patient paid 200 CNY, among which 100 CNY was paid to each involved telemedicine center. The lectures were free. [49]

3.5.2.8 Project by Neusoft Medical Systems Co. Ltd, Shenyang

Neusoft Medical Systems Co. Ltd, Shenyang was founded in 1998 in Shengyang. Its main aims are developing and producing large medicine systems, and providing holistic solutions for hospital digitization. It has a producing center occupying an area of 23 000 m^2, and several internationally first-class producing lines for computed tomography (CT), magnetic resonance imaging (MRI), X-ray machine, and ultrasound machine. In 2004, it founded a subsidiary company jointly with Royal Philips Electronics of Netherlands to develop and produce medical systems together. [70]

In 1999, Neusoft invested 20 000 000 CNY in telemedicine satellite network project [72]. In 1999, Neusoft began research in store and transfer of digital image. In 2000, it started research in telemedicine system. In 2001, the telemedicine system was finished and integrated with its independent satellite network, and then the formal application of the telemedicine project began. In 2002, it launched ground broadband telemedicine solution and holistic telemedicine solution. In 2003, the teleradiologic solution with integrated hardware and software was launched. In 2004, virtual teleconsultation center, virtual telemedicine subsidiary network solutions were launched, and distributed teleradiologic branch centers began to be constructed. In 2005, telemedicine became its core service, and a project of remote data exchange platform was launched [71].

Neusoft telemedicine project had already about 200 consulting hospitals. The teleconsultation request volume in medical imaging diagnosis amounts to 60 per day in its teleconsultation administrative center. Recently, Neusoft is responsible to found a telemedicine network in Fujian Province, with 80 hospitals will become its new members [40].

3.5.2.9 Project of Medical School, University of Beijing

Telemedicine Center, Medical School, University of Beijing was founded in 2005. It is managed and promoted by Medical Investment Company, Medical School, University of Beijing. Its main goal is utilizing the advantages of the medical resources in the university to provide consulting hospitals with technological supports, in order to solve the problem that it is difficult for the patients from remote areas to visit the famous doctors in Beijing. [71]. Store and forward system is used in the project. The reply for the teleconsultation request can be sent back to the consulting hospital in 24 to 48 hours. In July 2006, the County Hospital of Suiyang, Liaojing Province became the 20th cooperative hospital of the center [40].

3.5.2.10 Project jointly by Ruike Medical Instruments Co. Ltd, Shanghai and Ministry of Health

In October 2007, Ruike Medical Instruments Co. Ltd, Shanghai and Ministry of Health signed an agreement on informatization dermonstration project in rural area. Ruike will donate property costing 20 000 000 CNY to Ningxia Hui Autonomous Region in the demonstration project. The project includes: 1. implementing teleconsultation between hospitals in county and township to enable rural patients conveniently to visit doctors; 2. training rural medical staff though telemedicine network with existing resources in the medical institutions above the county level; 3. establishing electronic archives for rural patients, to provide them with persistent health administration. The demonstration project will be implemented locally and last for two years, and then it will be generalized in western areas [72].

3.5.2.11 Telepathology Project in Fuzhou

The Fuzhou telepathology project was funded by National Natural Science Foundation and Major Science and Technology Project, Fujian Department of Science and Technology, and implemented by Department of Pathology, Fuzhou General Hospital, Nanjing Military Region, Fuzhou. A website named as Chinese Telepathology Center (http://www.cicp.org.cn) was founded in 2000. It is the first large formal professional website in pathology in China. The services of the website include teleconsultation, teleeducation, product information, symposium, and others. [73]. Professionals in pathology and manufacturers or agents of pathology-related products can register at the website to publish their articles or images for free [73]. From March, 2001 to June, 2003, teleconsultations were undertaken in 395 cases, among which the diagnoses were rendered in 387; whereas the diagnoses were not able to be made in only 17, due to the insufficiency of image quality or insufficient number of images [74].

3.5.2.12 Statistics of the Commercial Projects in General Medicine and Pathology

Totally 14 projects in telemedicine and telepathology (Herein each project under Golden Health Projects is considered as an independent project) were found in the literatures (see table 1). 12 projects were launched from 1995 to 2001; whereas 2 were launched after 2001 until now. Telecommunication approaches applied included satellite, ISDN, DDN, ASDL, telephone line, and others. The videoconferences applied included both products from abroad and domestic. Among all the 14 projects, 11 used real-time teleconsultation modality; 2 used store-and-forward; there was not report in the teleconsultation modality in the other project. Except unknown number of teleconsultation stations in consulting hospitals in 2 projects (project 13, 14), 1079 were founded under the other 12 projects. The number of teleconsultation stations in consulting hospitals under each project ranged from 18 to 280 (mean 89.9). About 16638 teleconsultations were reported (the teleconsultations in project 7 and 11 were not taken into account). The number of teleconsultation under each project ranged from 100 to 5304 (mean 1848.7). The number of teleconsultation per hospital per year ranged from 1.8 to75 (mean 15.6). Until the time we did the research, among the 14 project, 7 projects were still active, the statue of 6 projects were not able to judge, and one project was inactive.

All the 14 projects' originating sites were located in the east parts of China (see figure 7). There are only fragmentary data about the locations of teleconsultation stations founded in each projects in the literature, therefore it was not possible to mark the locations of teelconsultation stations in the map.

Table 1. Characters of the Commercial Projects in General Telemedicine and Telepathology

Project code	Starting date	Telecommunication approach	Main instrument	Teleconsultation approach	Consulting hospital N	Teleonsultation N	Reporting date	Teleconsultation hospital/year# N	Current Statue
1	1997	satellite	Creative ShareVision PC 3000	real-time	20	3000	1999	75	N
2	1995	-	-	real-time	168	1182	1999	1.8	-
3	1995	satellite, DDN, ISDN, ATM telephone line, etc	-	real-time	48	650	1998	4.5	Y
4	1995	Telephone line, satellite	Polycom products	real-time	211	5304	2001	4.2	Y
5	1995	-	-	real-time	100	3774	2005	3.8	-
6	1995	-	-	real-time	18	-	1999	-	-
7	1996	Internet	self-developed videoconference system	real-time	80	hundreds	1999	-	-
8	1997	ASDL	AVCON	real-time	90	2000	2007	2.2	Y
9	1998	ATM	Healthstation 2000	real-time	26	100	2000	1.9	-
10	2001	special line	Viewstation EX H 323	real-time	18	233 (5 months)*	2006	31.1	Y
11	2001	satellite, broadband	Neusoft products	real-time	280	60/daily**	2006	-	Y
12	2005	Internet	-	SAF	20	-	2006	-	Y
13	2007	-	-	-	-	-	-	-	-
14	2000	Internet	-	SAF	-	395	2003	-	Y

Data are n.
Project codes 1-10 represent the following projects:
1. Project by Golden Health Medical Network Engineering Co. Ltd, Institute of Medical Administration, Ministry of Health
2. Project by Chinese Medical Board
3. Project by University of Fudan, Shanghai
4. No 2 Military Project
5. Project by Huashang Hospital, University of Fudan, Shanghai
6. Project in Xuzhou
7. Project by Shanghai Science & Technology Investment Co. Ltd
8. Hunan Province
9. Project in Shandong Province
10. Project in Henan
11. Project by Neusoft Medical Systems Co. Ltd, Shenyang
12. Project of Medical School, University of Beijing
13. Project jointly by Ruike Medical Instruments Co. Ltd, Shanghai and Ministry of Health
14. Telepathology Project in Fuzhou
- unknown; Y the project is active now; N the project is not active now
* total teleconsultations in 5 months; ** 60 teleconsultation per day in the single consultation center; the other data in this column are total teleconsultations;
#number of teleconsultation per consulting hospital per year.

Figure 7. Originating sites of commercial projects in telemedicine and telepathology in China.

3.4.3 Publications in Teleconsultation and Telemedicine in CNKI and PubMed

Table 2 shows detailed numbers of publications in teleconsultation and telemedicine in CNKI and PubMed. The ratio of publications in teleconsultation in CNKI and PubMed is 1:2.5; whereas the ratio of publications in teleconsultation in CNKI and PubMed in 1: 3.6.

Figure 8, 9, and 10 are aimed to display the year-after-year quantitative changing trends of publications in teleconsultation and telemedicine in CNKI and PubMed, and to compare the similarities and differences of the changing trends between the publications in CNKI and PubMed.

Table 2. Publications in Teleconsultation and Telemedicine in CNKI and PubMed

Year	Publication in teleconsultation in CNKI N	Publication in telemedicine in CNKI N	Publication in teleconsultation in PubMed N	Publication in telemedicine in PubMed N
1960-1970	0	0	0	0
1970-1980	0	0	2	27
1980-1990	0	1	3	34
1991	0	0	1	5
1992	0	0	0	47
1993	0	0	1	74
1994	0	6	4	123
1995	2	14	86	353
1996	14	59	142	457
1997	55	121	149	658
1998	92	210	161	783
1999	93	253	220	804
2000	112	288	256	819
2001	112	312	242	718
2002	102	318	259	714
2003	93	284	216	758
2004	58	215	246	793
2005	37	154	186	833
2006	71	203	189	807
2007	59	192	186	733
01.01-02.29.2008	0	3	8	55
Total	**900**	**2633**	**2557**	**9595**

Data are n.

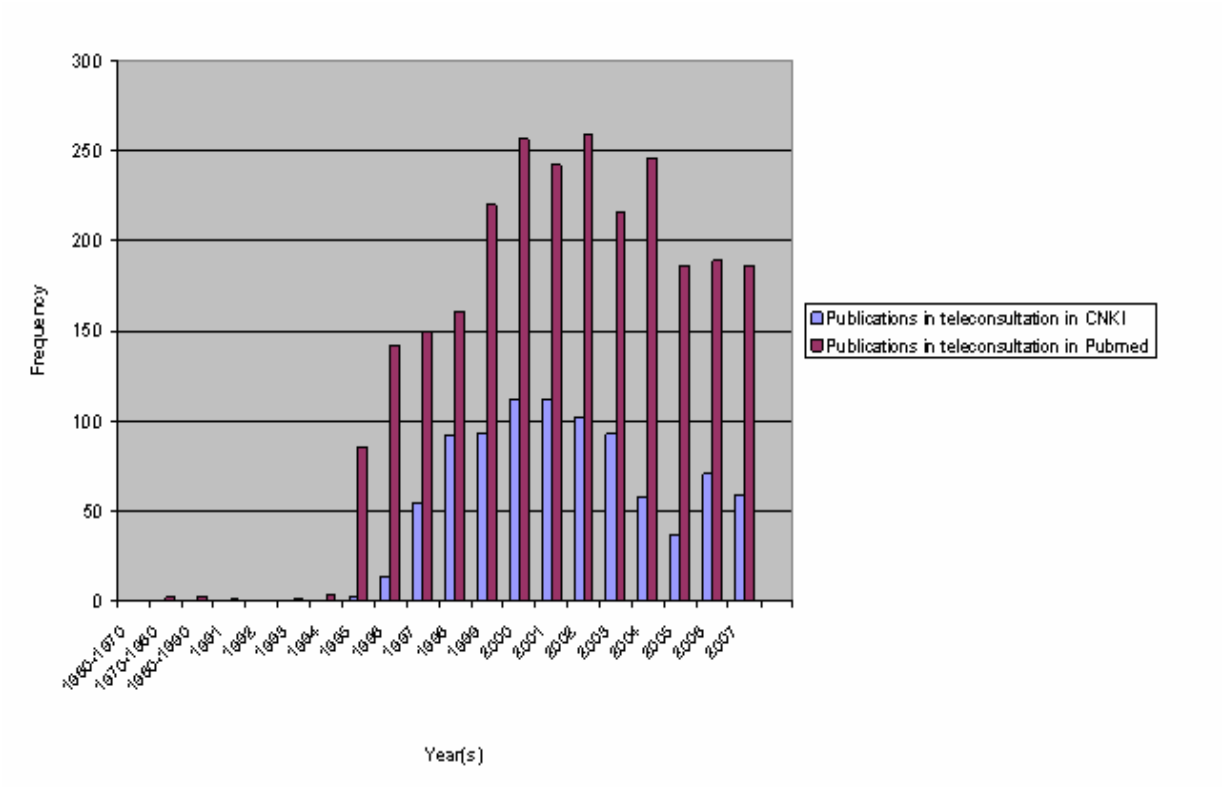


Figure 8. Publications in teleconsultation in CNKI and PubMed.

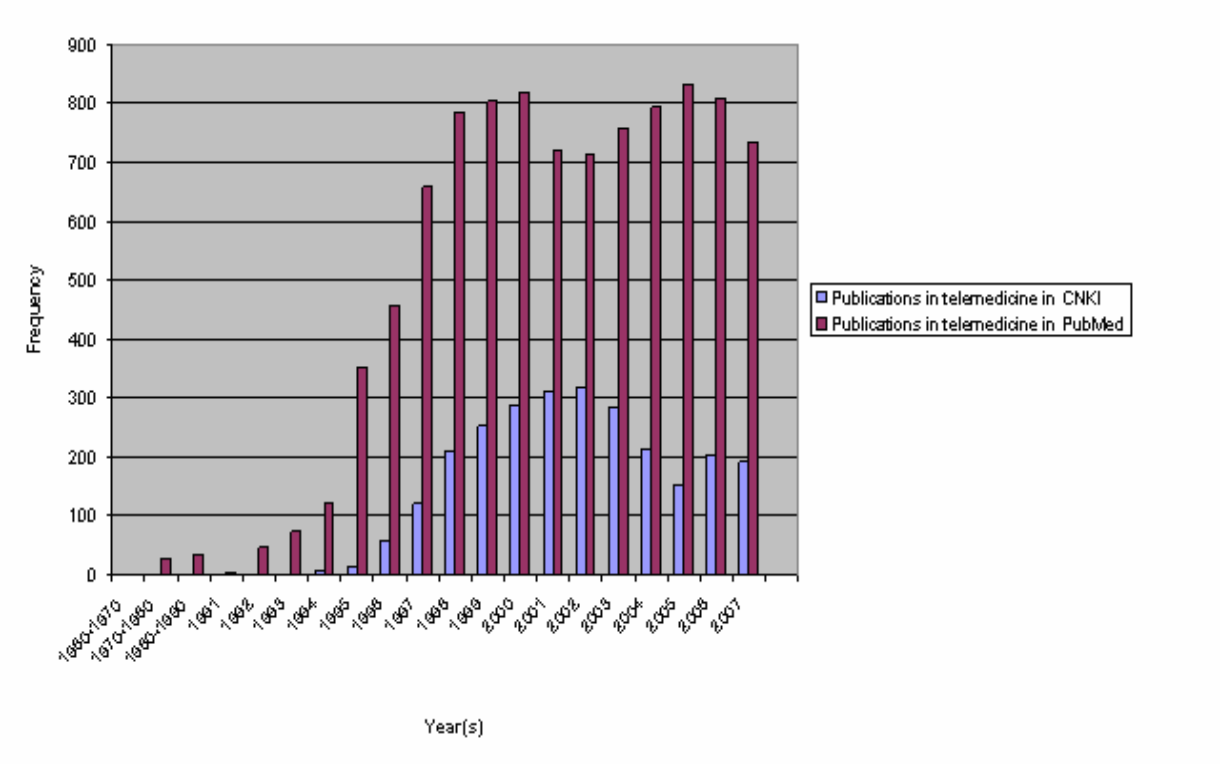


Figure 9. Publications in telemedicine in CNKI and PubMed.

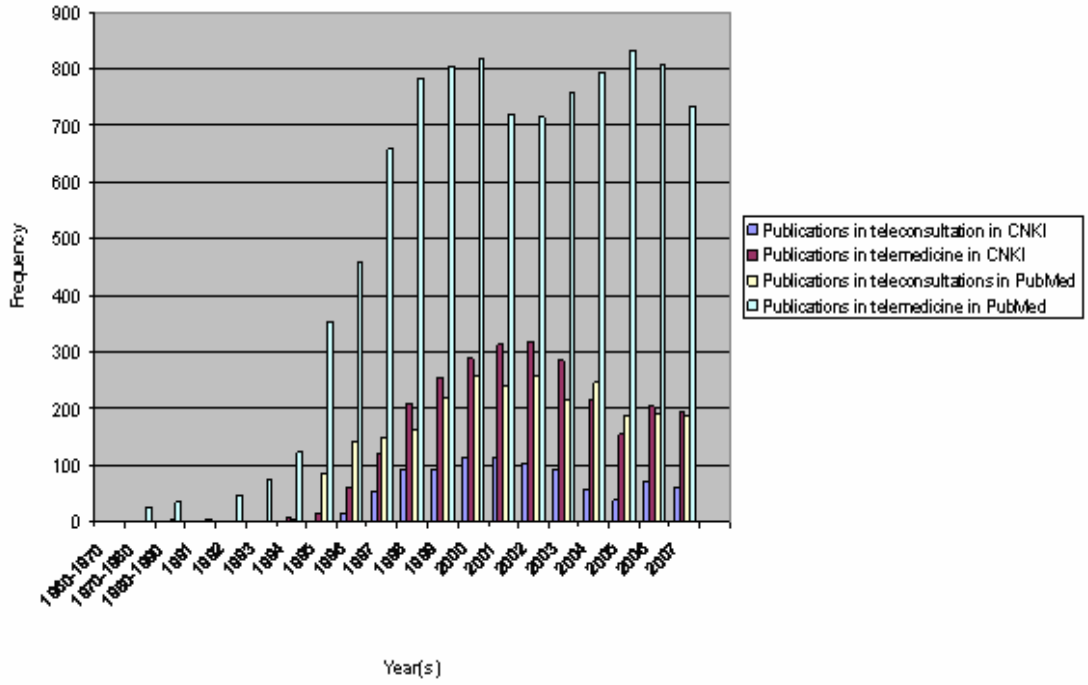


Figure 10. Publications in teleconsultation and telemedicine in CNKI and PubMed.

3.4.4 Websites in Dermatology

3.4.4.1 Website of Chinese Society of Dermatology

Chinese Society of Dermatology is the dermatological branch of Chinese Medical

Association. It was founded in April, 1934 in Shanghai. [75] At its website, the society' history, organization, regional branches, main specialists, academic and working conferences, academic journals, departments eligible to enroll doctorate students, progress in dermatology, dynamic information of the society, main manufacturers or agents of dermatology-related products are introduced and published. [76] A forum is also founded at the website, but we didn't browse it because the McAfee SiteAdvisor warned the webpage might cause a breach of browser security. [76, 77] In addition, there is an online teaching atlas at the website. [78]

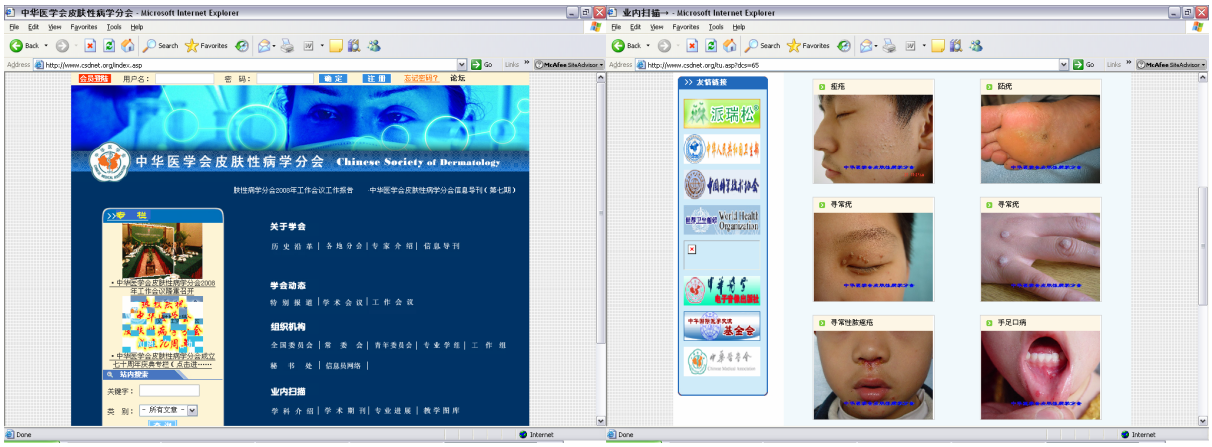


Figure 11, 12. Homepage of the website of Chinese Society of Dermatology [76] and the online teaching atlas at the website. [78]

3.4.4.2 Website of China Dermatology Association of Chinese Medicine

China Dermatology Association of Chinese Medicine is a branch of China Association of Chinese Medicine. It was founded in October, 2004 in Wuhan. [79] At its website, the main columns include: "Brief Introduction of the Association," "News and Trend," "Science Disseminating," "Famous Doctor and Hospital," "Science and Technology Cooperation," "Patient Thought," "Continuous Medical Education," "Cosmetology in Chinese Medicine," "Traditional Minority Medicine," "Typical Case," "Difficult Case," "Electronic Book." [80] "Patient Thought" column is a forum where registered patient can submit query and registered dermatologist can answer the query. [81] "Typical Case" and "Difficult Case" columns are forums where registered dermatologist can submit typical or difficult cases, or participate in the discussion of the submitted cases. [82, 83]

Figure 13, 14. Two forums at website of China Dermatology Association of Chinese Medicine: "Patient Thought" [81] and "Difficult Case". [83]

3.4.4.3 Website of Chinese Dermatology and Venereology

The website of Chinese Dermatology and Venereology was founded by Department of Dermatology, Xijing Hospital, the Fourth Military University in April, 2000. It has the following columns: “Professional Information,” “Medical Service,” “Online Teaching,” “Community Exchange,” “Case Discussion,” and “Member Service.” [84, 85] Now the “Community Exchange” and “Case Discussion” columns can not be retrieved. [86, 87]

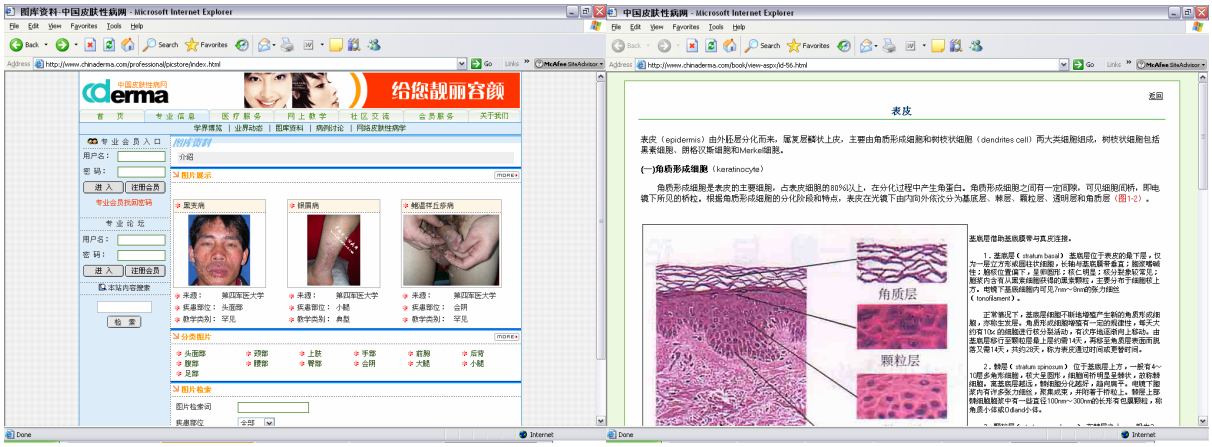


Figure 15, 16. Online atlas [88] and online dermatology book [89] at the website of Chinese Dermatology and Venereology.

3.4.4.4 Forum in Dermatology and Venereology at LilacGarden Website

The website of LilacGarden Science and Technology in Biomedicine was founded in July, 2000, aimed at creating an exchange platform for professionals in medicine and life science. Now the website has about 1 000 000 users in medicine, pharmacology, and life science. The daily visits count up more than 120 000. The visits in last 7 years totaled 1 000 000 000. It is well-known in medical staff working in grade A tertiary hospitals (Grade A tertiary hospital is the highest level of hospital in China.) with 90% knowledge rate. [90]

Figure 17, 18. Forum in Dermatology and Venereology at the website of LalicGarden Science and Technology in Biomedicine [91] and a case for discussion at the forum (one can access only after logging in.). [92]

At the website, forums in various medical disciplines are founded. The columns in forum in dermatology and venereology include: “Cutaneous Disease,” “Dermatopathology,” “Sex Education and Sexually Transmitted Diseases,” “Dermatosurgery and

Cosmetology," "Dermatology in Traditional Chinese Medicine," "Progress in Scientific Research," "Lecture from Specialist," "Resource," and "Help." [91]

3.4.4.5 Website of Deyu Dermatological Medicine

The website of Deyu Dermatological Medicine is founded by Professor Deyu Chen and his students, Department of Dermatology, the Affiliated Hospital, Luzhou Medial College, Luzhou. [93] It has the following columns: "Dermatologist," "Medical Atlas," "Progress in Scientific Research," "Teaching Resource," "Academic Conference," "Postgraduate Student," and "Leisure Park." In its major column "Medical Atlas," there are thousands of images. [94] The images come from Prof. Zhihua Wu's Color Atlas in Dermatology and Venereoloy, Prof. Dengchang Wang's Color Atlas of Human Skin Tissue, Prof. Xuejun Zhu's Color Dermatological Atlas, Prof. Shaoxi Wu's Color Mycological Atlas, and those collected from their own clinical work and Internet. [95]

Figure 19, 20. Online atlas [96] and teaching resource [97] at website of Duyu Dermatological Medicine.

3.4.4.6 Online Department of Dermatology

Online Department of Dermatology is the gateway website of Department of Dermatology, People's Hospital, Zhejiang. At this website, introduction of the staff of in the department; popularization knowledge for patient in dermatology, venereology, mycology, cosmetology; and conference news are published. [98]

3.4.4.7 Other Websites in dermatology

There are still other websites in dermatology. We are not sure about the founders' qualification. So, we only list the websites and their name below.

- http://www.wmp169.com/: website of Chinese Information in Dermatological Scientific Research
- http://www.sxpfb.com/: website of Chinese Specialists in Dermatology [49]
- http://www.bdfkf.com/hospital.php: website of Chinese Vitiligo Recovery
- http://www.zhnpx.com/index.htm: website of Chinese Psoriasis Recovery
- http://www.pfxb.net/index.html: website of Protection, Therapy, and Counseling in Dermatology and Venereology
- http://www.cnderma.com: website of Chinese Information in Protection and Therapy in Dermatology and Venereology
- http://www.derma.com.cn/: website of Venereology and Dermatology
- http://chinayxb.com: website of Chinese Psoriasis

- http://cuochuang.com: website of Chinese Acne [84]

3.4.5 Teledermatology between China and Austria

3.4.5.1 China-Austria Science and Technology Cooperative Program in Teledermatology

Dong H from Department of Dermatology, the First Teaching Hospital, University of Zhengzhou, Zhengzhou, China and Soyer HP from Department of Dermatology, Medical University of Graz, Austria applied for and finished two terms of program in teledermatology under the framework China-Austria Science and Technology Cooperative Program. Several other colleagues also temporarily involved in the programs.

- 2001-2003 China-Austria Science and Technology Cooperation Program (VI. B. 12): Teledermatopathology: an integrated approach
- 2004-2006 China-Austria Science and Technology Cooperation Program (VII. A. 17): Establish a network of excellence in dermatology between China and Austria

After implementing the programs, we finished the following works:

- Teleconsultation in dermatology: About 400 cases from Zhengzhou, China were discussed at http://www.telederm.org.
- Several full text papers or abstracts were published both in Chinese and international academic journals. [32, 33, 38, 49, 85, 99-109] We also cited them in this dissertation.
- A TeleDerm column was found in Dermatology World Report (previous Dermatology Times China). Up to now, 8 columns have been published. TeleDerm column includes mainly three parts: interview with famous dermatologists around the world, case selected from http://www.telederm.org, and news relevant to teledermatology or relevant to the interviewed dermatologist. The main aim of TeleDerm column is to promote teledermatology in China. Actually dermoscopy is also promoted by the column.
- Personnel exchanges between Department of Dermatology, the First Teaching Hospital, University of Zhengzhou, Zhengzhou, China, and the Department of Dermatology, Medical University of Graz, Graz, Austria.

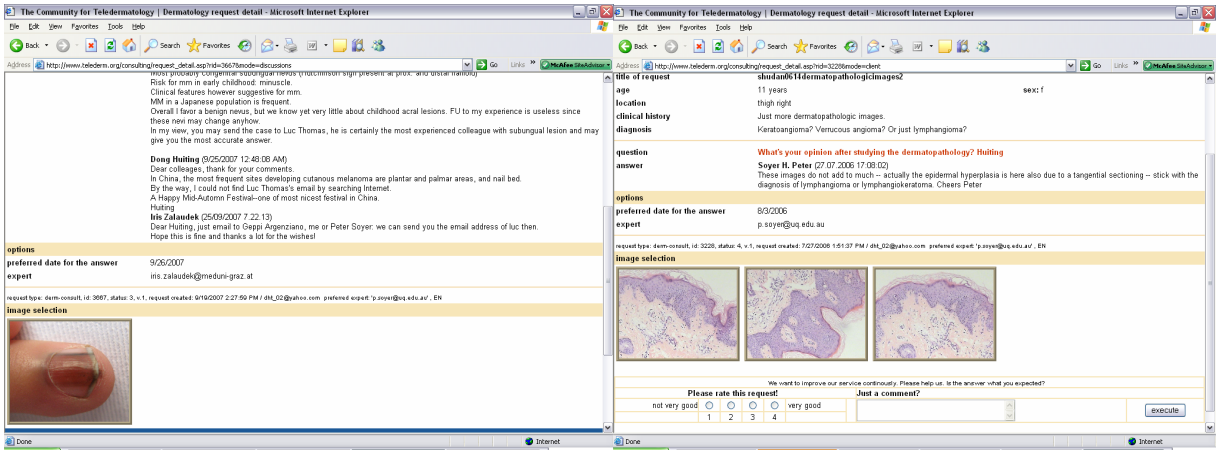


Figure 21, 22. Cases for discussion submitted at http://www.telederm.org from Zhengzhou, China.

Figure 23-25. The 8th TeleDerm Column in Dermatology World Report, which has 4 parts: 1. A case selected from discussion view at http://www.telederm.org; 2. News concerning teledermatology, including the information about e-learning course on dermoscopy by Department of Dermatology, Medical University of Graz, the Second World Congress of Teledermatology, and the Chinese visit of Prof. Karen McKoy from Harvard Medical University; 3. Interview with Prof. Karen McKoy and her short CV; 4. The education resources on teledermatology recommended by International Society of Teledermatology.

Figure 26. Prof. Helmut Kerl, Prof. H. Peter Soyer, and Prof. Lorenzo Cerroni visited the Department of Dermatology, the First Teaching Hospital, University of Beijing, Beijing, China in 2006 under the 2004-2006 China-Austria Science and Technology Cooperation Program (VII. A. 17). In Beijing, they participated in the Annual Dermatopathological Session, Chinese Society of Dermatopathology.

Figure 27-29 In 2006, under the cooperation program, Prof. Helmut Kerl, Prof. H. Peter Soyer, and Prof. Lorenzo Cerroni also visited the Department of Dermatology, the First Teaching Hospital, University of Zhengzhou, Zhengzhou, China. Three lectures with titles “A Journey to the Heart of Dermatology – Dermatopathology”, “The value of clinicopathologic correlation for melanoma diagnosis”, “Emergencies in Dermatolopathology” were given by them, respectively.

3.4.5.2 Teledermatology Center in Medical College of Wenzhou

Teledermatology Center in Medical College of Wenzhou is founded jointly by Medical College of Wenzhou, China, and Medical University of Graz, Austria. It is set up in the First Affiliated Hospital, Medical College of Wenzhou. Prof. H. Peter Soyer, Department of Dermatology, Medical University of Graz is invited as academic adviser of the center. [110]

The center is a technological platform sharing international resource. Through this platform, skin-disease patients in China can obtain the medical service delivered by European specialists in dermatology; and the skin-disease patients abroad can also obtain the rapid medical service provided by Chinese specialists in dermatology. The center is also dedicated in academic exchange and cooperation, in improvement the diagnostic and therapeutic capability of Chinese dermatologists, and in promotion of the diagnostic and therapeutic standards in China to become in concordance with the international standards. [110]

Both real-time videoconference and store-and-forward teleconsultations are undertaken in the center. One real-time videoconference teleconsultation charges 500 to 2000CNY, and one store-and-forward teleconsultation 200 to 500 CNY from the patient. [111]

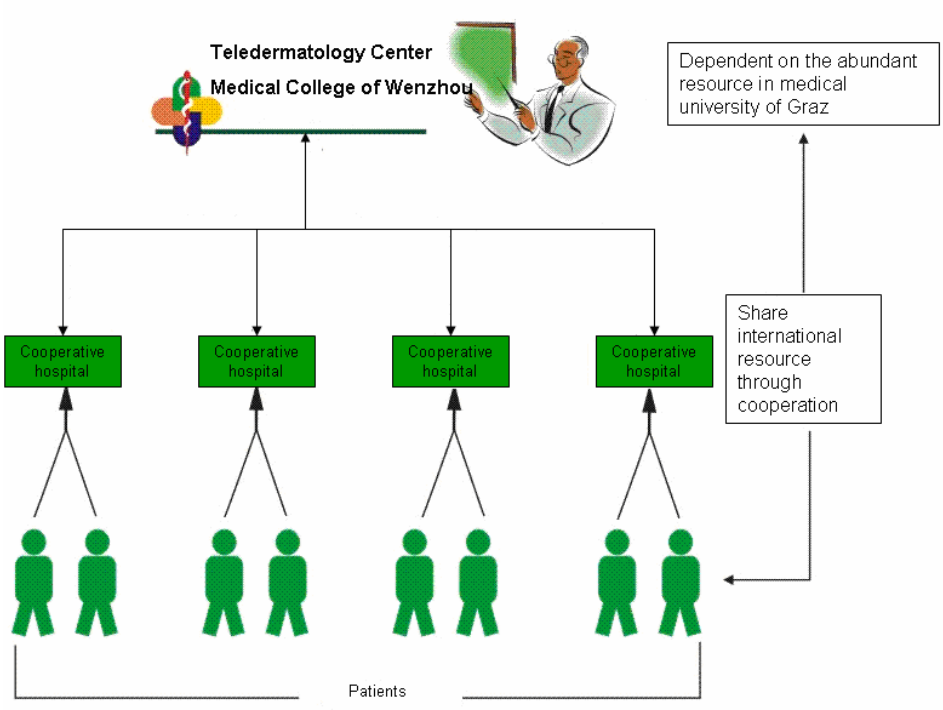


Figure 30. Service system of teledermatology center, Medical College of Whenzhou. [112]

3.4.6 Frequency of Teleconsultation in Dermatology among Teleconsultation in General Medicine and Pathology

7 publications were identified with statistics about the teleconsultation in various medical disciplines (see table 3). The hospitals involved in the teleconsultation projects totaled 226. Total duration amounted to 5049 month/hospital. Total teleconsultations added up 2631. The frequency of teleconsultations in dermatology among all the teleconsultations

ranged from 0 to 20.29%, with an average frequency of 2.43%. The frequency of teleconsultations in non-dermatology ranged from 54.55 to 99.14%, with an average frequency of 95.10%. The frequency of teleconsultations in others had a range from 0 to 45.45%, with an average frequency of 2.47%. Excluding the study [74] with unknown number of participated hospitals, the average monthly teleconsultations in general medicine and pathology per hospital was 0.41; the average monthly teleconsultations in dermatology, in non-dermatology, in others were 0.01, 0.39, and 0.01, respectively.

Table 3. Frequencies of Telecousultations in Dermatology, Non-Dermatology, and Other Medical Disciplines in Publications in Telemedicine and Telepathology

Author and publication date	Hospital N	System	Duration (month/hospital)	Dermatology N(%)	Non-dermatology N(%)	Other N(%)	Total N(%)
Zhou L et al, 1999 [113]	1	Real-time	24	0(0)	198(92.86)	12(5.71)	210(100)
Xue Q et al, 2001 [114]	1	Real-time	28	0(0)	162(77.14)	48(22.86)	210(100)
Lian P et al, 2001 [60]	221	Real-time	5304	28(1.18)	1475(98.12)	0(0)	1503(100)
Ke X et al, 2002 [115]	1	Real-time	36	0(0)	6(54.55)	5(45.45)	11(100)
Zheng Z et al, 2003 [74]	Unknown	SAF	Unknown*	20(5.06)	375(94.94)	0(0)	395(100)
Miao Q et al, 2006 [49]	1	Real-time	5	2 (0.86)	231(99.14)	0(0)	233(100)
Cheng B. 2007 [116]	1	Unknown	12	14(20.29)	55(79.71)	0(0)	69(100)
Total	226		5409	64(2.43)	2502(95.10)	65(2.47)	2631(100)

*The enrolling duration lasted 24 months in the study.

3.4.7 Introduction and Development of Innovative Products in Telemedicine

3 papers were selected as examples of the introduction of innovative products in telemedicine from abroad and development of the products at domestic.

3.4.7.1 Mobile Remote Monitor

Mobimed was developed by Ortivus Cooperate in Sweden first in 1991 and improved in later years. It has a user-friendly surface and is easy to be operated. Its patient unit is a mobile unit. It can be used at emergency sites and in ambulances. The data it collects can be sent to hospital in real time. The clinical workstation is designed for on-line consultation and patient information management. It enables the hospital team to assist the paramedics online with recommendations for treatment and to direct the ambulance to the most suitable hospital triage and ward. The transmitted information can be used for follow-up and exported to other systems and applications. The patient unit and the clinical workstation form a scalable, compatible and complete tool for accurate and reliable pre-hospital diagnosis, decision support, documentation, and assessment. [117] This product has been registered in Chinese State Drug and Food Administration.

3.4.7.2 Remote Pulse Diagnose System in Traditional Chinese Medicine

Teleconsultation in traditional Chinese medicine is limited because of inability of the consultant to remotely undertaken pulse diagnosis. A Chinese medical remote pulse diagnosis system is developed for objective pulse diagnosis in teleconsultation in traditional Chinese medicine. This system have solutions for three key problems in teleconsultation system for traditional Chinese medicine: 1. Patients can cooperate with consultant in undertaking pulse diagnosis; 2. Consultant can obtain the feeling of the

patient’s pulse on finger tip; 3. Expert system can assist in decision making [118].

3.4.7.3 Multiparametric Remote Monitoring System for Heart Function

The remote monitoring system is developed based on three tiers framework of ″Home-Community-Hospital″ for home monitoring. Its characteristics include multi-user concurrent operation, multiple testing parameters, real-time interactivity, dependable and secure data communication, high-speed link with database, and load balancing. According to user's requirements, various applications can be developed to improve medical information system based on B/S mode. A portable multiparametric tester based on embed system had functions of wireless transmission and web communication. Its design of software and hardware is modularized [119].

3.4.8 Significances of Teleconsultation

It is recognized that teleconsultation means services with better quality, lower cost and available in shorter time, because the patients can get specialist services without the need of travel, and receive correct management without delay. Teleconsultation especially can benefit patients in remote areas. [28, 120, 121] The resources in medical centers can be shared and utilized, and the influence of medical centers will be strengthened. [28, 120] The consulting doctors can improve their expertise through exchange with consultant doctors. [28, 120, 121] The patient volumes between medical centers and primary hospitals can be balanced and the income in primary hospitals will be increased. With improved service quality, medical deputes can be decreased. Furthermore, the specialists can avoid working in dangerous environments, such as in rooms with inpatients suffering from severe acute respiratory syndrome (SARS). [28]

3.4.9 Problems and Limitations in Teleconsultation

3.4.9.1 Administration, Coordination and Supervision

Implementing teleconsultation involves several parties, including hospitals in various areas, department of telecommunication, and manufacturers or agents relevant to teleconsultation. The supports, coordination, supervision from governments are not enough. [122]

Most teleconsultation stations usually are administrated by engineering and technical personnel as one of their concurrent jobs. They lack medical knowledge and expertise and limited time lead frequently to a suboptimal management of teleconsultation stations. The personnel managing the teleconsultation stations should have knowledge in computer, telecommunication, and medicine. [123,124]

3.4.9.2 Teleconsultation System and Infrastructure

The investment in the teleconsultation system and infrastructure, and in their maintenance and update are expensive, such as the investment in videoconference system and satellite telecommunication. When using telephone line for telecommunication, the speed is slow, and the connection is frequently broken. It has negative impact on the quality of teleconsultation. [123, 124, 125]

The government has not formulated integrated technological standards and medical

regulations in teleconsultation. Many hospitals independently developed software. The hardware and telecommunication channels applied are also of great diversity. Therefore, it is difficult to exchange and share medical information, and to realize open and interactive networking among all the hospitals in the whole country. [39, 59] Besides, China lacks minimum acceptable criteria of parameters for teleconsultation systems as well. [126]

3.4.9.3 Information Security and Legal Issues

According to the Chinese regulations on teleconsultation, the consulting doctor should be responsible for the possible medical disputes. [38] But when the patients' data were lost, destroyed, or exposed due to information secure issues, there are still no regulations or laws to define who should be responsible for the problems. [127]

3.4.9.4 Negative Attitude on Teleconsultation

Some administrators think that any diseases can be managed in their hospitals; therefore there are not needs for teleconsultation. [123] In an university hospital, only 11 teleconsultations were undertaken in three years' duration after teleconsultation station was founded. It is thought there are not so much needs for teleconsultation in the university hospital. [115] Some doctors doubt about the quality and effect of teleconsultation, and fear of the possibility inducing medical dispute by exposing their mistakes during teleconsultation; whereas other doctors think that they will lose face, or their own reputation will be influenced negatively if specialists are invited for teleconsultation. The doctors who are famous themselves at certain degree are particularly prone to think so. [125, 121, 126, 128] Most patients don't know about the teleconsultation program in the hospital, and some are not confident about teleconsultation. [125, 121, 127] Furthermore, the patient's payment on teleconsultation is thought to be expensive. One teleconsultation in Qinping Hospital, Minnan, Fujian Province costs 500 CNY. The patients are usually hesitant to undertake teleconsultation due to high price. [124]

3.4.9.5 Quality of Consulting and Consultant Doctors, and Quality of Consulting Hospitals

Although most invited specialists are excellent both at medical expertise and ethic, but some are arrogant and not on time. [125] When an invited specialist doesn't work in the professional field, in which the expertise is required in the teleconsultation for a given case, the specialist can not diagnose and manage well. [99] The specialists for selection are limited in some situations. [121] In addition, during teleconsultation, the specialists can not undertake physical examination personally, such as palpation, percussion, and auscultation, [129] and they can not undertake pulse-diagnosis as well in traditional Chinese medicine. [118, 131] If the consulting doctor can not provide complete and correct medical history, representative and clear medical images, and if the consulting hospital has no qualified laboratory tests and treatments [27, 99, 125, 128, 129] teleconsultation will be not helpful. For example, when the consulting hospital does not have immunochemistry markers, which are important for the diagnosis, the telepathologist is not able to evaluate correctly the lymph node pathology. [131] Moreover, when the difference of expertise between consulting doctor and specialist is too large, the consulting doctor has difficulty to understand the specialist correctly. [132]

3.4.9.6 Evaluation of Teleconsultation Projects

It is difficult to evaluate teleconsultation projects, because it would include comprehensive evaluation of service quality, patient satisfaction, cost-effectiveness, and influence on healthcare system. Therefore, patient, doctor, project manager, and governmental department should be involved in an evaluation. [126] Usually, it is thought teleconsultation can decrease the medical cost for patient, and can increase the income of consultant hospital. [28] However, the institutes who invested in teleconsultation may not be able to ultimately benefit from the teleconsultation projects. Until now, there are still no well-designed studies on cost-effectiveness analysis of teleconsultation in China. [126]

3.4.10 Suggestions and Perspectives

3.4.10.1 Unify Standards, and Formulate and Implement Policy Guideline

It is suggested that an administrative institution should be founded in governmental health department to strengthen the supervision and guidance of teleconsultation in China. The operational standards, technological and informational standards, and pricing standards should be unified. The fundamental functions and working flow of teleconsultation should be standardized. Health Level Seven (HL7) should be applied in order to provide unified information access standard, to materialize the information exchange between the application modules within hospital, between hospital and community, and between hospital and hospital. The ultimately goal is to realize the genuine share and utilization of medical resources. [126, 127]

3.4.11.2 Improve Regulations and Laws, and Define Responsibilities

The relevant regulation and law should be improved, according to the legal issues and problems relevant to responsibilities in teleconsultation. The specialists in computer science, telecommunication, medicine, and law should be invited to participate in studying and formulating the regulation and law prospectively, in order to define the responsibilities clearly. [126, 127]

3.4.11.3 Improve the Patient and Medical Staff's Attitude

Low patient volume is a factor to limit the growth of teleconsultation. Effective disseminating approaches should be developed to improve patient and medical staff's attitudes on the value of teleconsultation. [116, 125-127]

3.4.11.4 Strengthen Quality Management

Quality management should be implemented in all the components and processes of teleconsultation, including the quality of teleconsultation system and infrastructure, and the quality of consulting doctor and specialist's performances. [116, 125]

3.4.11.5 Support Research in Teleconsultation

Although the investment in teleconsultation in China is increasing, there are still no objective evaluations in the cost-effectiveness of teleconsultation projects until now. Quantitative cost-effectiveness analyses are needed. [126] At the same time, the

business mode should be improved according to the demands from large-scale patients, and operation benefit should be paid attention to. Teleconsultation, an advanced technology, should not only be able to decrease the patient's expenses, but also reduce the hospital's cost and increase the hospital's economic benefit. [125-127]

3.4.11.6 Reduce Cost of Teleconsultation

Financial subsidization by government is a method to reduce teleconsultation costs in remote areas in America. In China, this measure should also be taken [126].

3.4.11.7 The Future of Teleconsultation in China

With the development and integration of new technologies, the quality of teleconsultation services will be improved and its cost will be decreased. The previously barriers can be broken. [39] The future of teleconsultation in China will be integrated in health information system and e-health system. [127, 133] Teleconsultation will enter into small hospitals and clinics in remote areas, and even into patient's home and wherever it is needed. [39, 127] Doctors can utilize shared medical resources and can access patient's data anywhere and anytime to manage patients more timely and correctly. [39] New economic modes will be developed to enable teleconsultation to be beneficial to all involved parties, and its market share will be increased. [127]

4 Discussions

4.1 Telemedicine in China

4.1.1 Evolving Stages and Trends in History

We mainly focused on teleconsultation in this review, but nearly all the teleconsultation projects have broader goals with conferencing and teaching. [135] Furthermore, our results of publications dealing with teleconsultation and telemedicine in CNKI and PubMed show that the evolution trends in teleconsultation and telemedicine are similar, no matter whether in Chinese publications or English publications.

Our results indicate that the history of telemedicine in China can be divided vaguely into three stages, which may overlap.

Firstly, Chinese telemedicine experienced a demonstration stage from 1986 to about 1994. In this stage, what are known from publications remain individual teleconsultation dermonstrations, and rather dramatic reports showing the amazing role of teleconsultation. But all the demonstrations seemed only aimed at demonstrating technological feasibility of teleconsultation; whereas no one worked on demonstrating its economic feasibility. In addition, we can imagine that there should be underlying intensive science and technology research and development processes, and commercial processes during this stage and even earlier. No publications were found in this stage.

Then, telemedcine in China ran into a rapid implementation stage, which started from about 1995 and ended in around 2001. During this stage, Chinese government provided special policies in the development of informatization in healthcare, in which telemedicine was included. The government also formulated regulations in teleconsultation to standardize the practice of teleconsultation. Among all the 14 projects

that we identified from publications, 12 were launched in this stage (see table 1). Totally 1059 teleconsultation stations were founded and 16638 consultations were undertaken. In this stage the publications in teleconsultation and telemedicine in China also were also growing continuously, from 2 in 1995 to 112 in 2001 and from to 6 in 1994 to 318 in 2002, respectively (see table 2).

After 2001, telemedicine in China has been staggering in a fluctuating stage. The teleconsultation projects in publications began to decrease. We only found two projects. Under one of the projects, only 20 teleconsultation stations were founded; whereas the organizer of the other project just signed their agreement with Chinese Ministry of Health to implement demonstration project in 2007. [72] The publications in teleconsultation in China also show a declining trend after 2001, dropped to 37 in 2005; whereas the publications in telemedicine fell to 154 in the same years. Both increased thereafter, but there is still a fluctuating trend.

Our results (see table 2, figure 8-10) show the year-after-year quantitative changing trends of Chinese publications in teleconsultation and telemedicine in CNKI, and those of English publications in teleconsultation and telemedicine PubMed have similar patterns, from grew slowly at the beginning to grow fast thereafter to its peaks, and then dropped for a few years before growing again. Although the changing trends of Chinese publications may a few years behind the trend of English publications, the total publications are not humble: there are 900 and 2557 (ratio 1:2.5) publications in teleconsultation in CNKI and PubMed, respectively; and there are 2663 and 9595 (ratio 1:36) publications in telemedicine in CNKI and PubMed.

4.1.2 Analysis of the Underlying Reasons for the Historical Changes

Wang X et al and Liu F studied the literatures in telemedicine published before 2004 and before 2005, respectively. [136, 137] Liu F only enrolled Chinese publications; whereas, Wang X et al studied both Chinese and English publications. The quantitative changing trends in publications are similar to our results, when only data before 2004 or 2005 are considered (see figure 8-10, 31-33).

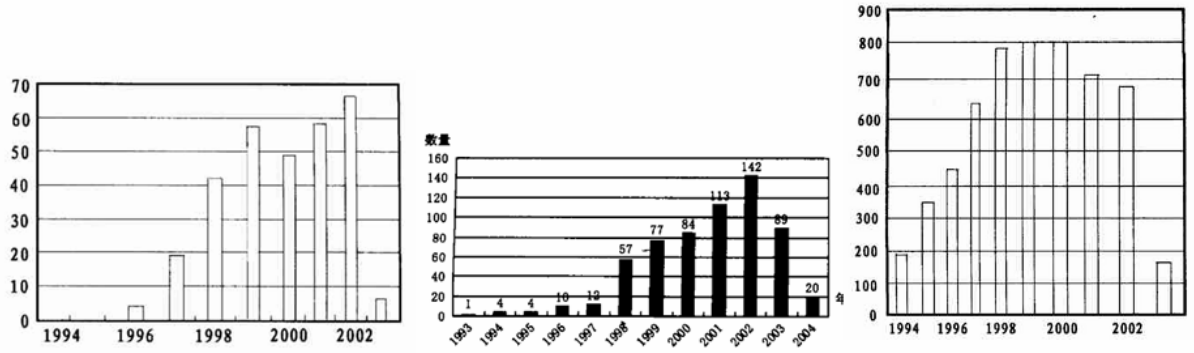


Figure 31-33. Annual numbers of publications in telemedicine in CBMdisc2004, [136] CNKI, [137] and Medline. [136]

Wang X et al explained the underlying reasons causing changes in publications in telemedicine. In about 1997, with the maturation and popularization of Internet and computer technology, many telecommunication and Internet companies increased their investment, and cooperation in healthcare. Following this trend, many developing countries also invested in informatization implementation in healthcare. This is why the publications in telemedicine grew fast from 1996 or 1997. In 1999, the dot-com economy reached its peak and its bubble broke. Many large telecommunication enterprises went

bankrupt. The publications in telemedicine went on increasing after 1999 a few years and then began to drop, which reflected the dot-com situation during this period. However, Wang X et al also thought the turbulence in telecommunication and information science and technology had no great impact on China. Because China began telemedicine relatively later; and Chinese enterprises and research institutes began to find the approaches in telemedicine that fitted for China. Furthermore, they began attaching more importance to cost-effective, mature technology that fitted for China rather than the advanced technology that is only innovative. [136] However, our results show both Chinese publications in teleconsultation and telemedicine declined markedly after 2002, which is different with the thoughts of Wang et al. Actually, in their publication, there are no data about the publications in telemedicine after 2003, and the data in 2003 is not complete. So, the opinion of Wang et al about the influence on China coming from the crisis in telecommunication and information science and technology was not based on valid data.

Whereas Liu F thought the decline of publications in telemedicine in China from around 2000 just reflected the fact that people decreased his or her concern to telemedicine after its popularization. [137]

However, we think there may other reasons causing the decline of publications in telemedicine after fast growth.

From 2000 to 2002, Currell R et al, Whitten PS et al, Roine R et al, and Mair F et al published their respective systematic reviews in telemedicine. [138-141] All findings concerning cost-effectiveness of telemedicine is quite discouraging. Currell R et al admit the feasibility of telemedicine, but find little clinical benefits and no cost-effective analysis in telemedicine. They suggest that random trial should be done in telemedicine, and that policy makers should be cautious about recommending of use and investment in unevaluated technologies. [138] Whitten PS et al also find no good evidence that telemedicine is a cost effective mean of delivering health care, after analyzing of 55 of 612 identified articles that presented cost benefit data. [139] Roine R et al conclude that the evidence concerning the effectiveness or cost-effectiveness of telemedicine is still limited. Based on current evidence, only a few telemedicine applications can be generalized. [140] In addition, study by Mair F et al indicate that patients do accept teleconsultation in various circumstances. However, further studies are required in the issues concerning that weather the patients are satisfied with teleconsultation, because of the methodological flaws in the existing publications. [141]

In China, there are also no valid evidences in cost-effectiveness analysis in telemedicine [126]. However, according to the statistics in our results, we estimate telemedicine itself economically is not sustainable for the consulting hospitals; despite some authors thought telemedicine will have benefit for both patients and hospitals. [28, 120, 121] Our results show that before 2001, 12 projects were implemented (see table 1). Among the 12 projects, 11 used real-time teleconsultation system. Some earlier projects even used satellite for telecommunication. So the teleconsultation system and telecommunication approaches used at that time are rather expensive. However, the number of teleconsultation per hospital per year ranges only 1.8 to 75 (mean 15.6). The prices for teleconsultation in China are different in different areas. The price of one teleconsultation in telemedicine center, the First Teaching Hospital, University of Zhengzhou was 600 CNY before 2001 [49]; the price under project by Golden Health company ranged from 300 to 1000 CNY. [40-47] In addition, the price the patient paid is for two sides,

consulting hospital and consultant hospital. We also have to consider the cost of room, the cost of teleconsultation system and telecommunication approach, and the cost of personnel involved in teleconsultation. Therefore, no matter how expensive the price that the patients think, 1.8 to 75 (mean 15.6) teleconsultations per hospital per year could not economically sustain the teleconsultation station. This may be one of the main reasons that the publications in teleconsultation and telemedicine dropped after around 2000 in China. Furthermore, our results show that during implementation of telemedicine, China encountered many problems, and teleconsultation has its own limitations. These problems and limitations may also be the reasons.

4.1.3 Solutions and Perspectives

Nevertheless, it is usual that in the beginning, as well as in the whole process of implementing a new technology, there will be anticipated and unanticipated problems and barriers, especially if it means redistribution of interests in society in a certain sense. Our results indicate that many authors had gradually realized the existing problems in telemedicine in China. They have been thinking about and have been proposing solutions of the problems. Most important is that telemedicine can meet the needs from society, as showed in our results. In addition, telemedicine can also play a role in collaborative research, which will be showed in the second part of this dissertation. Furthermore, our results show that the introduction of new technology from abroad and development of innovative products at domestic have never been stopped. These new technologies and products will facilitate telemedicine to provide service with better quality. At the same time, telemedicine will become more secure, more affordable, and more convenient. Thinking from another dimension, we can also anticipate the potential competition and conflicts of interest in the future due to the new products. Our results show that the future of teleconsultation in China will become an integrated part in hospital information system and e-health system. However, it is not easy to predict when this implementation will take place, how furious the competition during the implementing process will be, and how great the risks will be imposed on the teleconsultation providers.

4.2 Teledermatology in China

4.2.1 Teledermatology among Teleconsultation Projects in General Medicine and Pathology

Our results proved our presumption that teleconsutlation projects in general medicine and pathology include teleconsultations in dermatology. However, the frequency of published teleconsultations in dermatology among teleconsultations in general medicine and pathology ranged from 0 to 20.29%, with an average frequency of 2.43%. The average monthly teleconsultations in dermatology per hospital were only 0.01; and at the same time, the average monthly teleconsultations in general medicine per hospital was 0.41. Changing the unit of the last value into teleconsultation per hospital per year, it is 4.92. This is in accordance with another result of ours given in table 1. We found that the numbers of teleconsultation per hospital per year ranged from 1.8 to 75. It is obvious that such a small volume of teleconsultations is not enough to economically sustain the teleconsultation stations. However, we should notice that the teleconsultation stations in China are usually independent of any clinical departments of medical disciplines. They are managed by technical personnel or nurses, who themselves have no patients. Perhaps a specialized teleconsultation station in certain clinical discipline will be better.

4.3.2 Specialized Projects in Teledermatology

4.3.2.1 Projects at Domestic

Our results show that up to now, no profit projects specialized in dermatology has been reported. In the recent years, some professional societies, and some departments of dermatology founded websites to provide information service for professionals and/or patients, online books and atlas for education purpose. In a few websites, forums were founded for patient-to-doctor consulting or for doctor-to-doctor opinion exchanging (The founders may not know that patient-to-doctor online consulting is not permitted according to the governmental regulations.). Some companies also founded either websites specialized in dermatology or just forums in dermatology in a website with more comprehensive medical disciplines. In this dissertation, we mainly concentrated on websites specialized in dermatology. We know that in China, there are many websites in general medicine, [85] which also provide information service for professionals and patients in dermatology. The quality of websites in dermatology in China varied greatly.

4.3.2.2 Teledermatology between Austria and China

From 2000, Department of Dermatology, Medical University of Graz, Austria initiated cooperation in teledermatology with two departments of dermatology in China, Department of Dermatology, the First Teaching Hospital, University of Zhengzhou, and Department of Dermatology, Medical College of Wenzhou.

The cooperation between Graz and Zhengzhou in teledermatology had been sponsored by science and technology exchanging programs from bilateral governments, who only provide financial support for mobility of personnel. The cooperation remains the natures of academic exchanging and collaborative research.

Our questionnaire survey, which was undertaken among 68 dermatologists from 12 hospitals in Henan in 2002, shows that 95.3% of dermatologists hope to become terminal clients or experts of the international teledermatology network. They may encounter cases that are difficult to handle. The difficult cases make up 1% to 30% of their total patients. [32] After http://www.telederm.org was launched and 8 “TeleDerm” columns published in Dermatology World Report (former Dermatology Times China), 47 Chinese dermatologists from various areas in China did register at http://www.telederm.org, who showed interests in teledermatology. However, the registered Chinese dermatologists who really participated in the cases discussions were just a few. Following reasons may be responsible: 1. The aforementioned study may have bias, as most dermatologists participated in the survey knew Dong H. They were likely to show positive attitude when participating the survey undertaken by an acquaintance and colleague. 2. Language barrier. Most Chinese dermatologists can not communicate in English well. 3. Chinese dermatologists may fear of losing face, as suggested by some Chinese authors. In some forums in dermatology in China, the participated dermatologists do not use their true names, [92] which may be a convenient solution. However, anonymous will violate the HONcode, with which telederm.org is in compliance, because it is not possible to identify the qualification of the users who submit cases or participate in discussion. [142] 4. In the last years, the website of http://www.telederm.org was only a prototype. It had its own flaws. There were no specialist criteria and quality guarantee system for the teleconsultation at the website.

There were also no professional organization and market promotion. [14, 104] 5. Despite there will be substantial benefit for dermatologists who participate in the discussion forum at telederm.org in improving their expertise, there are also other similar websites provided similar services both in China and in English-speaking world. [83, 92, 104] There are other ways to improve one's expertise, such as reading classic books and academic journals in dermatology, and attending to local academic conferences and case-discussion sessions. Furthermore, it is not recognized in China to participate in such forum. Colleagues can not obtain academic credits, and it is not useful for professional promotion.

Another questionnaire survey among 476 patients with skin diseases in 12 hospitals Henan and one hospital in Wenzhou in 2002 shows that although at that time, only 7.6% of the Chinese skin disease patients had knowledge of telemedicine, only 6% of the patients had personal experiences in telemedicine, and only 3.6% of them had experiences in visiting European dermatologists previously; 87.3% Chinese skin-disease patients still will certainly or possibly ask European dermatologists for teleconsultation when it's available in China. [107] These results seem very promising, but it should be verified after formal implementation of teledermatology between Austria and China. However, if the teledermatology cross borders were implemented commercially. There may be conflicts in interests with local dermatologists. If they are against international teledermatology, they have great influences on public in China. They have long-term relationship with patients and usually have certain relationship with local media. In addition, competition can also motivate local dermatologists to improve their expertise.

Our skin disease spectrum analysis in Department of Dermatology, the First Teaching Hospital, University of Zhengzhou shows the top 10 common skin diseases are: 1. urticaria (10.01%); 2. acne (6.69%); 3.eczema (6.59%); 4. psoriasis (4.32%); 5. neurodermatitis (3.66%); 6. vitiligo (3.62%); 7. non-specific dermatitis (2.84%); 8. seborrheic dermatitis (2.73%); 9. verruca plana (2.30%); 10.herpes zoster (2.12%). The patients with top common 10 skin diseases accounted for 89.76% of total annual outpatients. Among all the 9880 patients, specific diagnosis were made in 9572 (96.88%), non-specific diagnosis were made in 291 (2.95%), and there were 27 (0.27%) patients suffered from extremely unusual skin diseases and even non-specific diagnosis were not be able to be rendered. These skin diseases with unspecific diagnosis and with no diagnosis may be indications for teleconsultation as an alternative approaches. [33] Searching for possible reasons for an unspecific diagnosis and cases with no diagnosis one can suggests a lack of expertise of the responsible dermatologists and also a lack required further examinations in the hospital. Moreover, we have to consider that limitations of current medical science exist.

Our experience and research in teledermatology show that there are no particularly differences between teleconsultation in dermatology and in other medical disciplines in China. [99] So the benefits and problems in teleconsultation in dermatology are same as those in teleconsultation in general medicine. It is evident that in developed countries, the medical resources and medical education are much better than in China now. Therefore teledermatology between the two countries would be of benefit for Chinese patients and dermatologists. Nevertheless, implementing teleconsultation between Europe and China one has to consider the difficulties between countries with different races, different economic statues, different health care systems and medical insurance systems, different culture backgrounds. In our experiences, the incidences of some skin diseases in the two countries may be different; clinical features of certain skin diseases

may also have different features; patients of different races and living in different environments may have different etiologies for certain diseases and may have different responses to certain treatments. Moreover, patients from different economic statues and culture background may have different preferences and expectations for medical service. These differences and their potential impact on implementing teledermatology between China and Austria remain to be further studied. In addition, the governmental policies about the licensure of foreign doctors to practice teleconsultation for patients in China should be checked, and the policies may change over time.

Under the cooperation between Graz and Wenzhou, Wenzhou founded a teleconsultation center in the hospital, and also founded a special domain at the hospital's website for teleconsultation. They try to cooperate with other hospitals to found a network. It seems that the cooperation between Graz and Wenzhou has a commercial perspective. However, no publications reported the current statues about the teleconsultation center in Wenzhou. According to the communication with Soyer HP in March, 2008, there were still no teleconsultations between the two departments.

4.3 Limitations of This Review

In this review, the projects in telemedicine are mainly identified in literature. There may be some projects in telemedicine and in teledermatology in China, which have never been reported in publications. Most of the opinions about the need of teleconsultation in China, the benefits and problems of teleconsultation, and the suggestions and solutions identified from literature are not originated from the authors' researches, but are derived from literature, or just mirror the authors' own opinions.

5 Conclusions

The history of telemedicine in China can be divided into three overlapping stages:

1. Demonstration stage (from 1986 to 1994): Mainly technologically demonstrating, without academic publications in teleconsultation and telemedicine.

2. Rapid implementation stage (from 1995 to 2001): Chinese government provided special policies in informatization and telemedicine in healthcare, and formulated regulations in teleconsultation. Commercial telemedicine projects were launched in large scale. Academic publications in teleconsultation and telemedicine increased quickly.

3. Fluctuating stage (from 2002 until now): Fewer projects were initiated. Academic publications in teleconsultation and telemedicine are decreasing in a fluctuating trend.

It is generally accepted that telemedicine can benefit patients, doctors, hospitals, and society in general as well. However, in implementing telemedicine, China encountered some problems. The fact that teleconsultation stations are not economically sustainable at present may be the main drawback. Besides, teleconsultation has been had its own limitations. Nevertheless, the existing problems in telemedicine in China have been addressed. The continuing introduction of new technology from abroad and development of innovative products at domestic may bring both hope and potential conflict and competition in telemedicine in China. In the future, teleconsultation in China will become an integrated part in hospital information system and e-health system.

However, it is not easy to predict its schedule and possible risks for telemedicine providers.

Teledermatology in China is included in some projects in general telemedicine and telepathology, but the volume remains still very low. Few domestic non-profit teledermatology projects exist, but commercial teledermatology projects are still lacking.

The Department of Dermatology, Medical University of Graz, Austria began cooperation with China in teledermatology from 2000. The cooperation between Graz and Zhengzhou has a nature of academic exchanging and collaborative research. The cooperation between Graz and Wenzhou shows a commercial perspective. Opportunities and risks concurrently exist.

6 References

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PART TWO

Dermoscopy of Genital Warts in Male: an Application of Teledermatology in Research

1 Background

Genital wart is also called venereal wart. It is a sexually transmitted disease (STD) caused by infection of human papillomavirus (HPV). [1, 2] It is an epidemic disease in the whole world. In developed countries, it is the most common STD currently. [3, 4, 5] It is estimated that the frequency of women in the world who are infected with HPV ranges from 2% to 44%; [6] whereas the frequency of infection differs in male in different countries, and it is difficult to compare due to the different methods used for taking samples. [7] Before 2001, genital wart in China was the second most common STD. [8] Since 2002, it has dropped to the third. [9] Genital wart usually can be diagnosed by naked eye, but it should be differentiated from seborrheic keratosis, lichen planus, condylomata lata, Bowenoid papulosis, and erythroplasia of Queyrat located on anogenital area. [10] Furthermore, clinically it's difficult to recognize its early subtype, the flat wart, with naked eye. Typical lesions of genital wart can be easily diagnosed on clinical observation, but it is necessary to undertake further laboratory examinations to make diagnosis for those that are not typical.

Up to now, rapid diagnostic techniques with high accuracy for genital wart are still lacking. [11] Aceto white test is simple and non-invasive, but it is not a specific test for HPV infection. Pseudopositive results can be observed in some chronic inflammatory diseases. [12, 13] Therefore, it is usually used for primary screening. [14, 15] Histopathology remains a reliable examination for confirming the diagnosis of genital wart, which has high specificity, but low sensitivity. [16-18] In addition, this invasive technique is not accepted by some patients. Moreover, in certain areas, it is difficult to take biopsy. With immunohistochemistry, the positive rate for checking HPV amounts to 50-60%, thus the sensitivity is lower than histopathology. [19] In-situ hybridization (ISH) at present is a sensitive, specific, and reliable approach for diagnosing genital wart, but the procedure of the test is very complicated, which limits its popularization in clinical application. [20] Currently, polymerase chain reaction (PCR) is the most sensitive method to detect HPV infection, but frequently pseudopositive results due to pollution of trace sample can be found. [21, 22]

Dermoscopy is a non-invasive, in-vivo diagnostic technique mainly applied in pigmented skin diseases. [23] With dermoscope, structures of skin surface and subsurface, which can not be seen with naked eye, will be visualized, such as the pattern of pigmentation, the size and morphology of superficial vascular plexus located in epidermis-dermis junctional, and upper dermis. Dermoscopy is a link between clinical dermatology and dermatopathology. [23, 24] Dermoscopic examination increases the diagnostic accuracy of pigmented skin lesions; especially it is a well established method in early diagnosis of melanoma. [25] It is also useful in evaluation of non-pigmented skin lesions, as it can recognize the vascular structures, which are not visible by naked eye. [26]

There are already reports in application of dermoscopy in human papillomavirus induced viral acanthomas, including plane warts, common warts, plantar warts, [27] and

epidermodysplasia verruciformis. [28] But until now there are still no publications in systematic description of dermoscopic patterns in genital warts, although Zalaudek et al mentioned their primary experience in dermoscopy of genital warts recently. [27] Our clinical observation indicated genital warts have certain distinct features worthy further study. Therefore the aims of this study are to systematically categorize and describe the dermoscopic features in genital warts, in order to reveal the potential clinical application of dermoscopy in the diagnosis and differential diagnosis of genital warts. Furthermore we investigated the possibility of a teledermatologic reproducibility of the defined dermoscopic patterns.

2 Materials and Methods

2.1 Patient Recruitment and Data Collection

42 lesions from 37 male patients with genital warts were enrolled sequentially from Department of Dermatology, the First Teaching Hospital, University of Zhengzhou, Zhengzhou, China from April 18, 2006 to September 13, 2006. Clinical enrolling criteria included: male patients with single or multiple papular lesions over anogenital area. The lesions may appear pearly, filiform, fungating, cauliflower, or plaque like, with smooth or veracious surfaces. The lesions may be either clinical typical or suspicious genital warts. All lesions were removed and we used the dermatopathological criteria for diagnosis of genital wart proposed by Wilbur [19] as the golden criteria to confirming the diagnosis of the 42 lesions:

- Diagnostic: epidermal acanthosis and papillomatosis with marked koilocytosis; usually with hyperkeratosis, parakeratosis, and thickness of granular layer as well.
- Suspicious: epidermal acanthosis; with or without papillomatosis; no marked koilocytosis; may with hyperkeratosis, parakeratosis, and thickness of granular layer.
- Non HPV infection: other inflammatory diseases, including pearly penile papule.

Dermatopathological diagnosis was rendered by two pathologists. For the cases having controversies, the dermatopathological images along with clinical data were submitted at http://www.telederm.org for second opinion (Soyer HP). Dermatopathological images were taken with digital microscope system (DP12, Sony Corporation, Tokyo, Japan) mounted on microscope (Olympus BX51, Olympus Optical Co. Ltd. Tokyo, Japan). Lesions, which were not dermatopathologically diagnosed as genital warts, were excluded. 12 lesions had to be excluded because dermatopathologically showed a seborrheic keratosis, a lichen planus or lesions where a specific diagnosis was impossible to make. We divided the 42 lesions into 4 groups according to their clinical subtypes, i.e. flat warts, smooth papular warts, classical pointed warts, and keratotic warts. [29] The regular medical record, clinical and dermoscopic images were also collected for each patient conforming to enrolling criteria. The clinical and dermoscopic images were taken with digital camera (Cyber-shot DSC-F707, Sony Corporation, Tokyo, Japan), and dermoscopic lens (Dermlite FOTO, 3 Gen, LLC, San Juan Capistrano, USA) mounted on digital camera. Dermoscopic images were studied with Soyer HP to identify and to define dermoscopic patterns in the genital warts. The dermocopic features of each lesion were evaluated and recorded (Shu D, Dong H) sequentially. Finally, all dermoscopic and clinical images of the 42 lesions were sent to Hofmann-Wellenhof R for further remote evaluation.

2.2 Main Outcome Measures

Relative frequencies of clinical subtypes, dermoscopic patterns and dermatopathological features.

3. Results

3.1 Clinical Features

The age of the 37 patients ranged from 17 to 64 years (mean 33.0 years). The durations of the 42 lesions ranged from 4 days to 2 years (median 6 months). Of the 42 lesions, the lesions were located on penis shaft in 26 (61.9 %), pubic symphysis in 5 (11.9%), scrotum in 4 (9.5%), coronary sulcus in 4 (9.5%), perianal area in 2 (4.8%), and groin in 1 (2.4%). Among 42 lesions, there were 7 (17.7%) flat warts, 13 (31.0%) smooth papular warts, 11 (26.2%) classical pointed warts, and 11 (26.2%) keratotic warts. In addition, among the 42 lesions, there were 8 lesions with markedly pigmentation, which represented the so called pigmented genital warts.

Table 1. Baseline characteristics of the patients and lesions

Characteristics	**Patient N=37**
Gender (male)	37 (100)
Age (years) *	33 (17-64)
Duration (months) †	6 (1-24)
	Lesions N=42(%)
Locations	
Penis shaft	26 (61.9)
Pubic symphysis	5 (11.9)
Scrotum	4 (9.5)
Coronary sulcus	4 (9.5)
Perianal area	2 (4.8)
Groin	1 (2.4)
Clinical subtypes	
Flat warts	7 (17.7)
Smooth papular warts	13 (31.0)
Classical pointed warts	11 (26.2)
Keratotic warts	11 (26.2)
Diagnosis confirmed by dermatopathology	42 (100)

Data are n or n (%), except *mean (range) or † median (range)

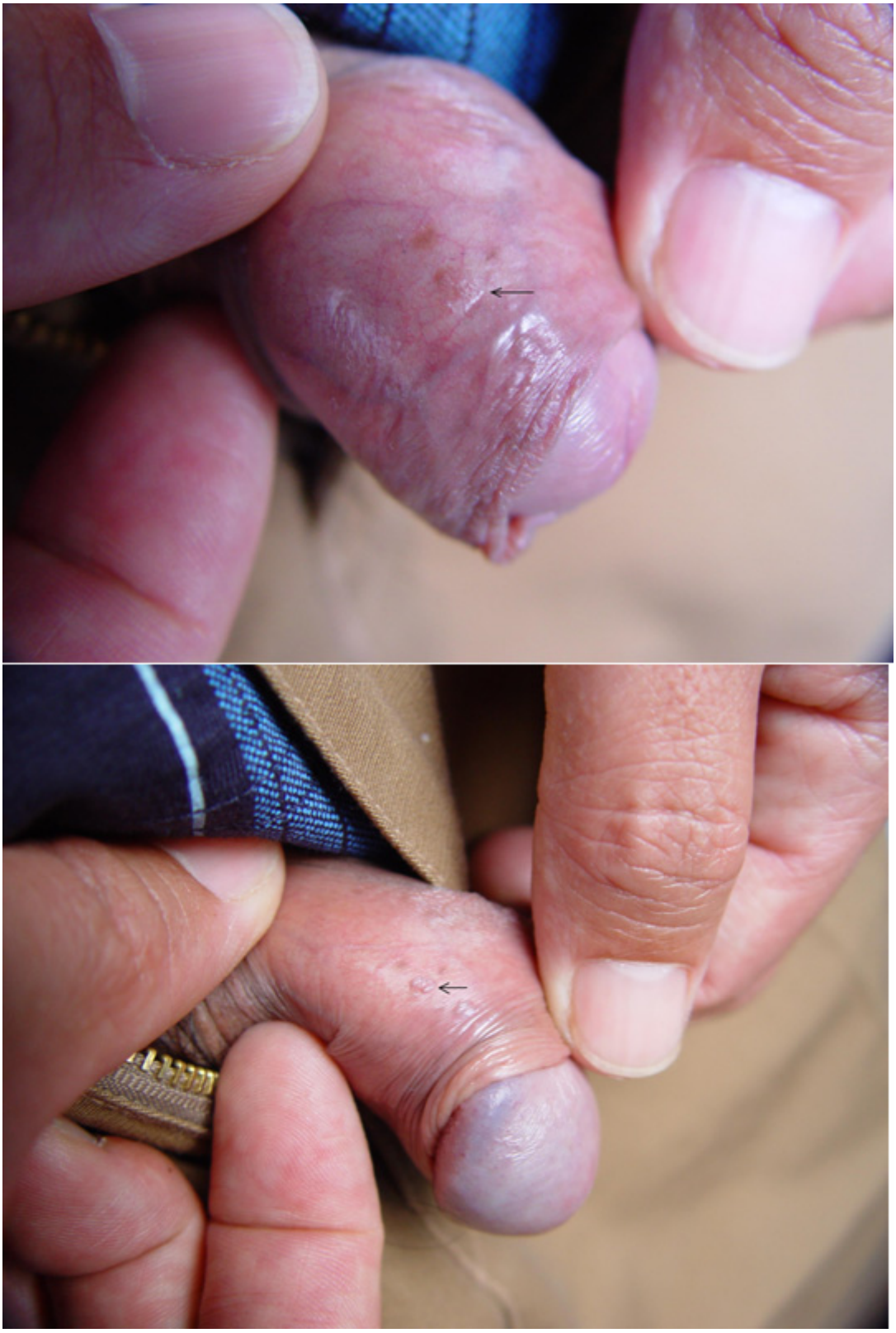

Figure 1, 2. Flat warts were difficult to be recognized with naked eye. After aceto white test they were better revealed.

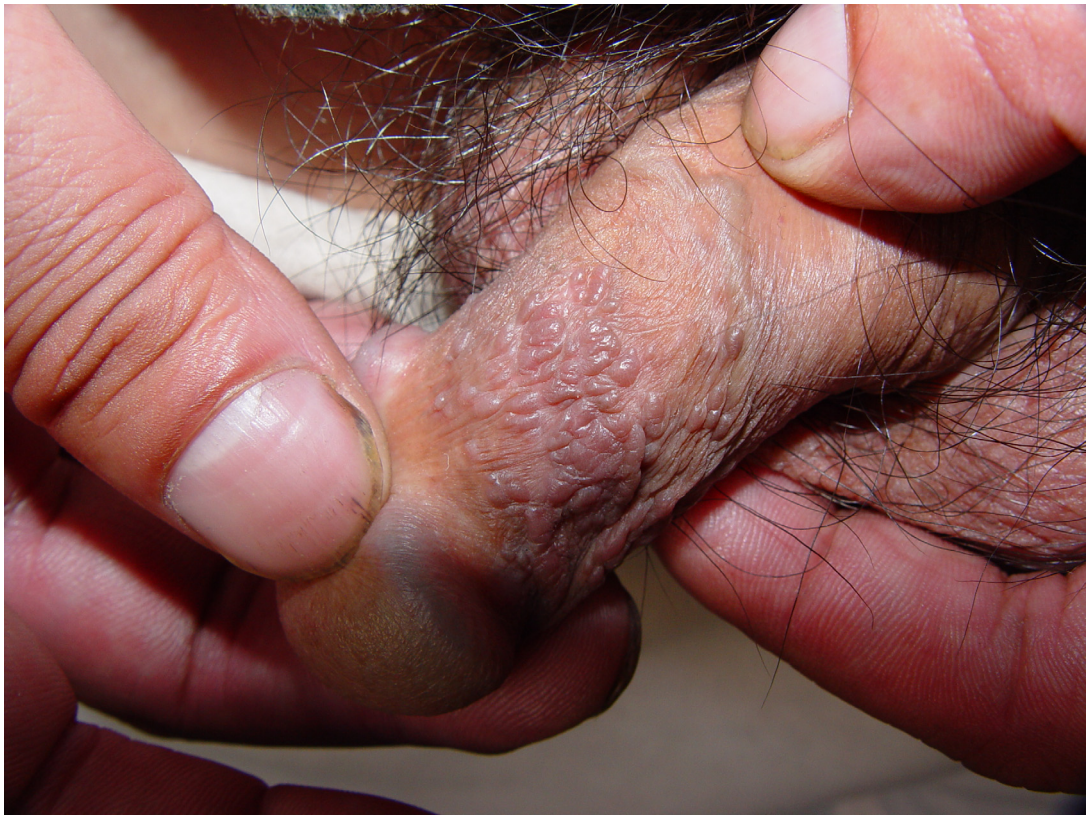

Figure 3. Smooth popular warts clinically appeared as smooth, circumscribed, elevated papules.

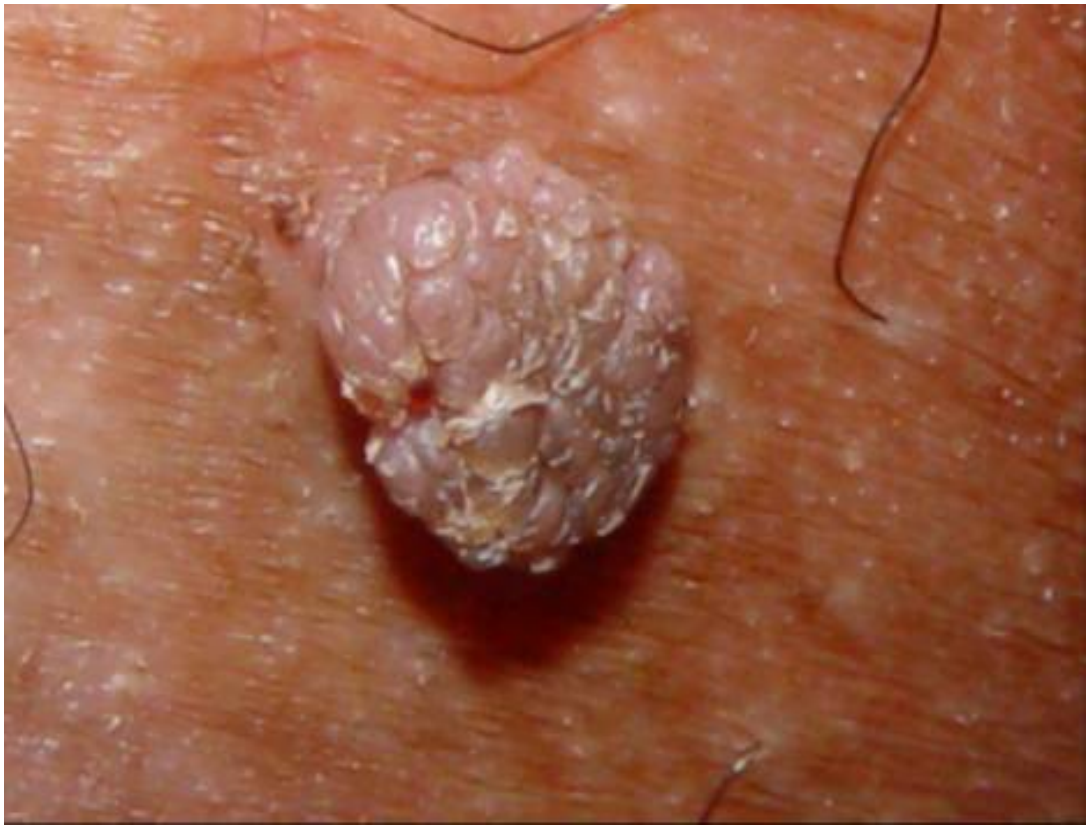

Figure 4. Keratotic genital warts were basically identical to common warts in appearance.

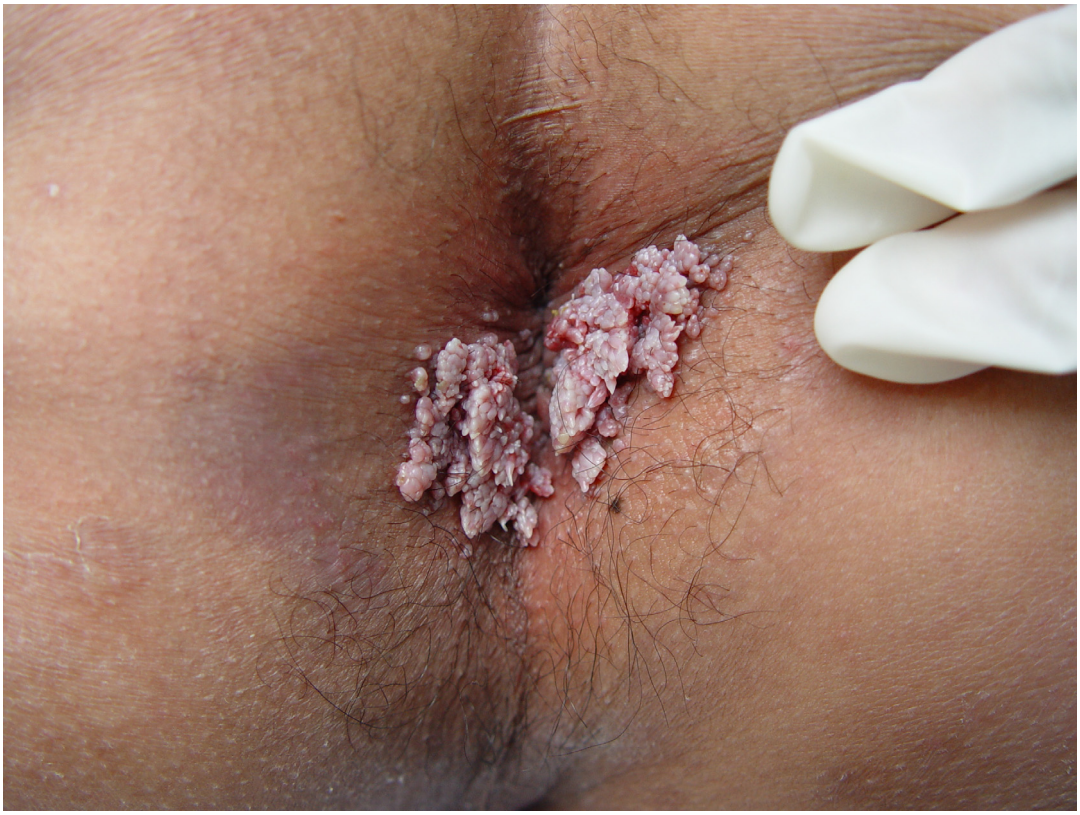

Figure 5. Classic pointed warts were soft, fleshy, and vascular, and had granular surface, usually with multiple small finger-like projections.

3.2 Demoscopic Features

Dermoscopic structures found in the 42 lesions included exophytic papillary structure, vascular structure, homogeneous structure, yellow-whitish structure, pigmentation, and gyri and sulci structure. Among exophytic papillary structures, we further defined three subpatterns, namely finger-like pattern, mosaic pattern, and mixed pattern. Vascular structures found in our study included dotted vessels, pomegranate vessels, irregular vessels, hairpin vessels, and thrombosed vessels. In addiction, we further divided vascular structures into two group, vascular structures located in the centre of each exophytic papillary unit and vascular structures not related to exophytic papillary structures. Among all the structures, most had been defined previously and also can be observed in other skin diseases [24, 30]. Herein we just defined the new criteria we found:

- Finger-like exophytic papillary structures: We referred to the exophytic papillary structures, in which exophytic papillary units were relatively longer and usually were separately markedly at the distant end. At the same time, the exophytic papillary units usually are similar in diameter but different in length. These features give this pattern a finger-like appearance.
- Mosaic exophytic papillary structures: We referred to the exophytic papillary structures, in which exophytic papillary units were relative shorter and were arranged tightly. The exophytic papillary units usually are similar in both diameter and length. The features of this pattern lead to mosaic appearance.
- Mixed exophytic papillary structures: We referred to the exophytic papillary structures, which partly had features of finger-like structures, and partly had features of mosaic structures.
- Yellow-whitish keratotic structures: We referred to the horny material adhere to the

surface of the lesion with yellow-whitish coloration.

- Pomegranate vessels: We referred to the hyperemia areas located in the centers of exophytic papillary units with round or oval shapes and similar sizes. These hyperemia areas combining the semi-transparent outer layers of exphytic papillary units surrounding them had a pomegranate-like appearance.
- Irregular vessels: the hyperemia areas located the centers of the exophytic papillary units with irregular shape and fuzzy borderline.
- Thrombosed vessels: We referred to the vessels, which were thrombosed. Therefore, they had dark-red, red-brownish, or black colorations.

The frequencies of dermoscopic structures found in different clinical subtypes of genital warts in our study were displayed in table 2.

Tabble 2. Dermoscopic structures in 4 clinical subtypes of genital warts

Dermscopic structures	Flat warts (N=7)	Smooth papular warts (N=13)	Classical pointed warts (N=11)	Keratotic warts (N=11)	Total (N=42)
Homogeneous struture	6	4	1	0	**11(26.2)**
Exophytic papillary structures	2	11	11	10	**34(81.0)**
Mosaic	1	9	0	2	**12(28.6)**
Finger-like	0	0	5	6	**11(26.2)**
Mixed	1	2	6	3	**12(28.6)**
Vascular structures	6	8	11	6	**31(73.8)**
Dotted vessel	3	1	1	0	**5(11.9)**
Pomegranate vessel	3	7	9	3	**22(52.4)**
Irregular vessel	0	0	3	1	**4(9.5)**
Hairpin vessel	0	1	5	3	**9(21.4)**
Thrombosed vessel	0	2	1	5	**8(19.0)**
Vascular structures in centre of EPS unit	1	6	11	6	**24(77.4)***
Vascular structures not related EPS	5	2	0	0	**7(22.6)***
Yellow-whitish keratotic Structure	0	3	1	10	**14(33.3)**
Pigmentation	3	8	0	0	**11(26.2)**
Gyri and sulci structure	0	3	1	2	**7(16.7)**

Data are n or n (%); EPS is abbreviation of exophytic papillary structure.
*N=31, N is total number of lesions with vascular structures.

In general, the most common dermoscopic patterns in genital warts in males were exophytic papillary structures and vascular stuctures, which were presented in 34 (81.0%) and 31 (73.8%) of all the 42 lesions, respectively. Yellow-whitish keratotic structures, homegenous structures, and pigmentations were also relatively common dermoscopic features in genital warts, which were found in 14 (33.3%), 11 (26.2%), and 11 (26.2%) of the 42 lesions, respectively. Gyri and sulci, were only presented in 7 (16.7%) of the 42 lesions.

Among 31 lesions with vascular structures, vascular structures were located in the centers of papillary units of exophytic papillary structures in 24 (77.4%); only in 7 (22.6%) lesion, vascular structures were not related to of exophytic papillary units. Actually, in these 7 lesions, there were no exophytic papillary structures.

Three subtypes of exophytic papillary structures were present in a similar frequency. Mosaic, finger-like, and mixed patterns were found in 12 (28.6%), 11 (26.2%), and 12 (28.6%) of the 42 lesion, respectively. Pomegranate vessels were the most common vascular structures and found in 22 (52.4%) of the 42 lesions. Among the other vascular structures, dotted vessels were found in 5 (11.9%), irregular vessels in 4 (9.5%), hairpin vessels in 9 (21.4%), and thrombosed vessels in 8 (19.0%).

There were different features in dermoscopic manifestations in the different clinical groups.

In the 7 lesions of flat warts, the main dermoscopic patterns were homogenous structures (6) and vascular structures (6). There were only dotted and pomegranate vessels, and most vascular structures were independent of exophytic papillary pattern.

In the 13 smooth papular warts, the predominant dermoscopic patterns were exophytic papillary structures (11), vascular structures (8), and pigmentation (8). Mosaic exophytic papillary structures (9) and pomegranate vessels (7) were the most common exophytic papillary structures and vascular structures, respectively. Most vascular structures were located in the centers of exophytic papillary units (6). Finger-like exophytic papillary structures were also relatively common (6)

In the 11 classic pointed warts, exophytic papillary structures and vascular structures were presented in all the lesions. There were only finger-like (5) and mixed (5) exophytic papillary structures. Pomegranate vessels remained the most common vascular structure (9), but most hairpin vessels were found in this group (5). All the vascular structures were located in the centers of exophytic papillary units.

In the 11 keratotic warts, the most prominent dermoscopic features (10) were exophytic papillary structures and yellow-whitish keratotic structures (10). Vascular structures were observed in only 6 lesions, but most thrombosed vessels were found in this subtype. All the vascular structures were located in the centers of exophytic papillary units.

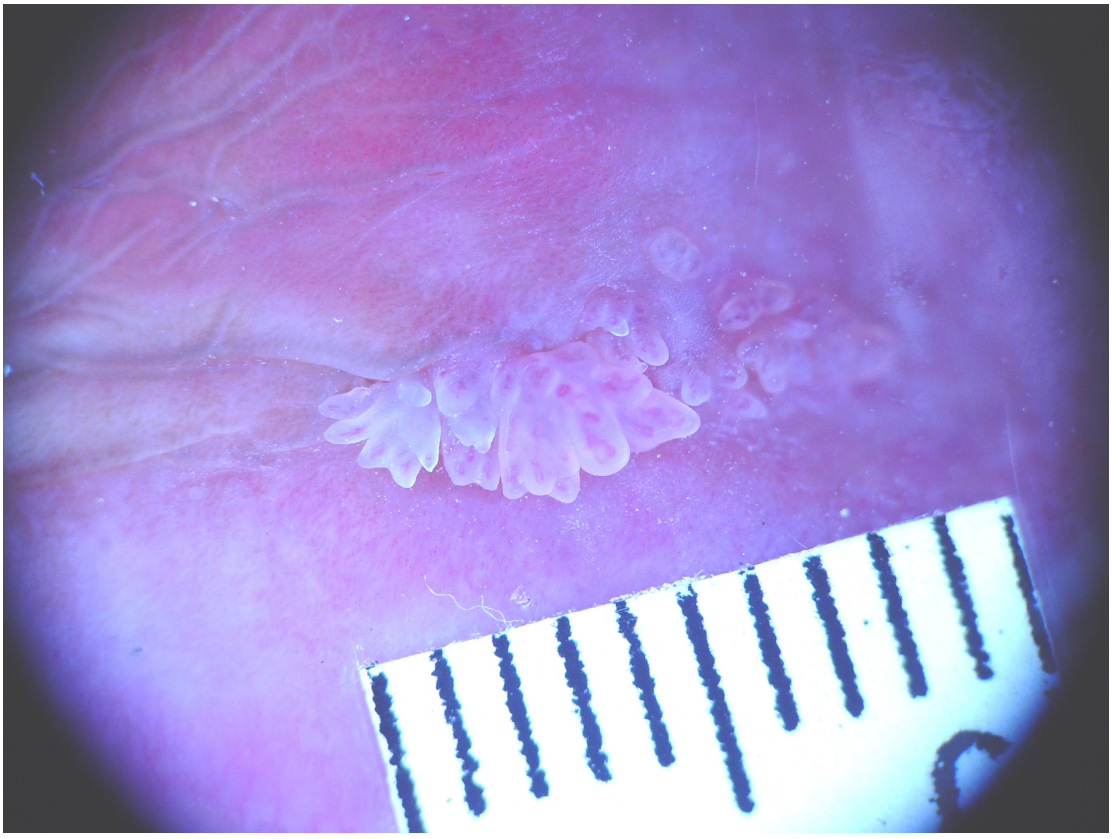

Figure 6. Finger-like exophytic papillary structures with central pomegranate and hairpin vessels in papillary units.

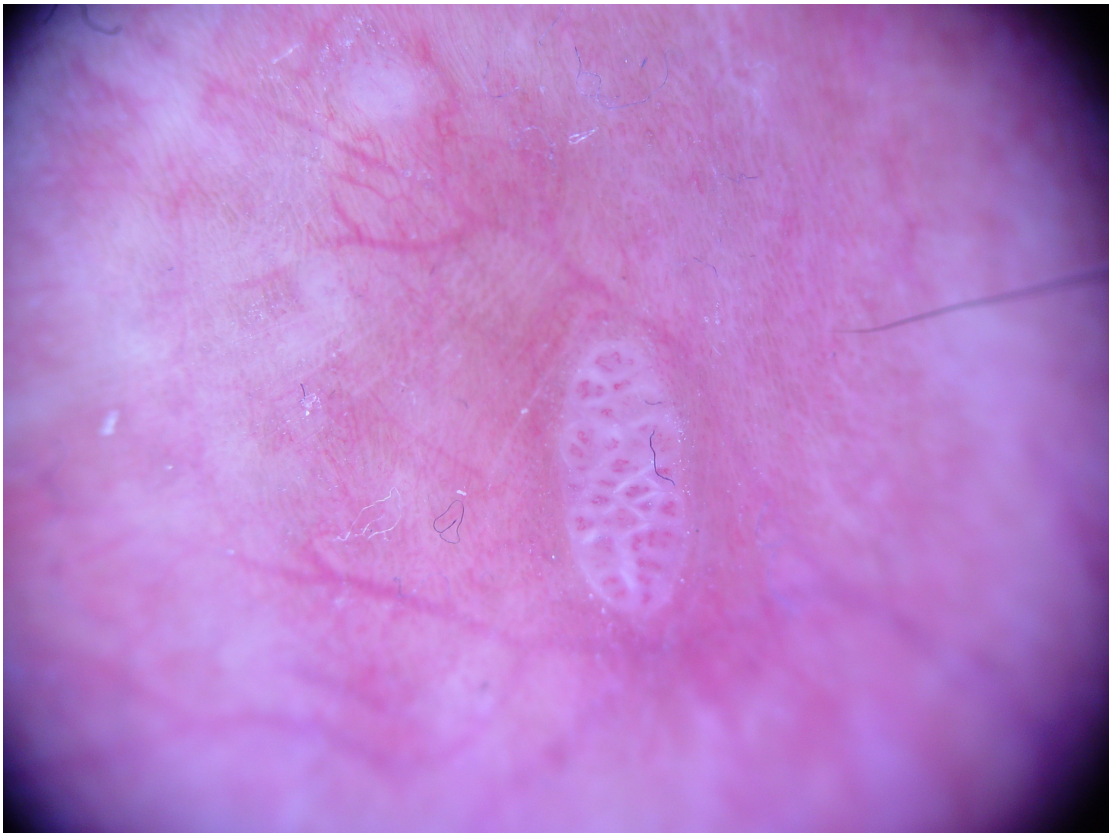

Figure 7. Mosaic exophytic papillary structures with central pomegranate vessels in papillary units.

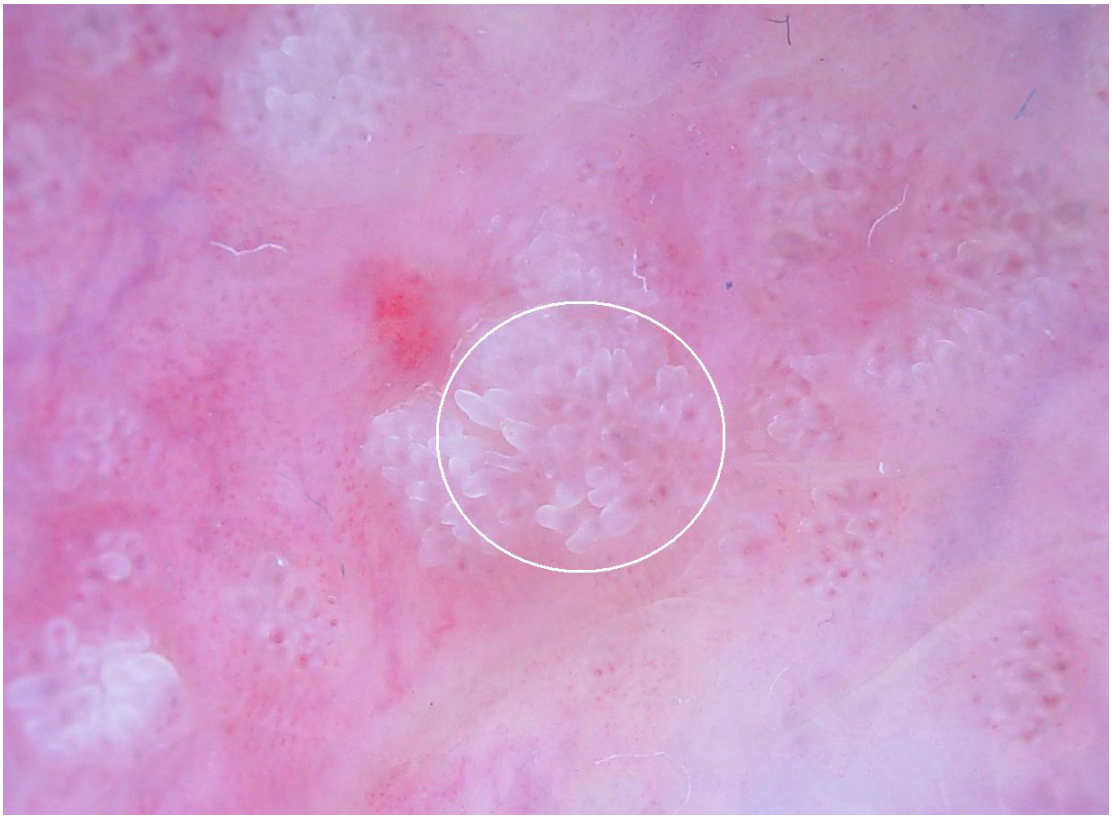

Figure 8. Mixed exophytic papillary structures with pomegranate vessels in the center of papillary units.

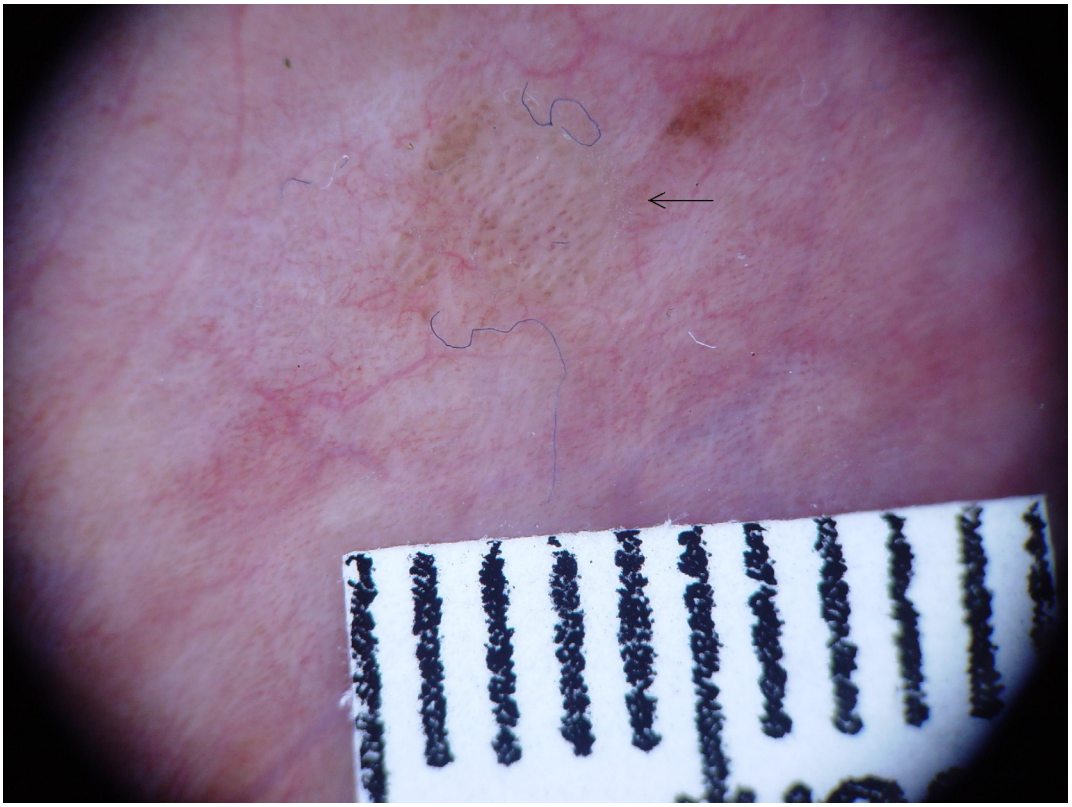

Figure 9. Dotted vessels with homogenous structure as background.

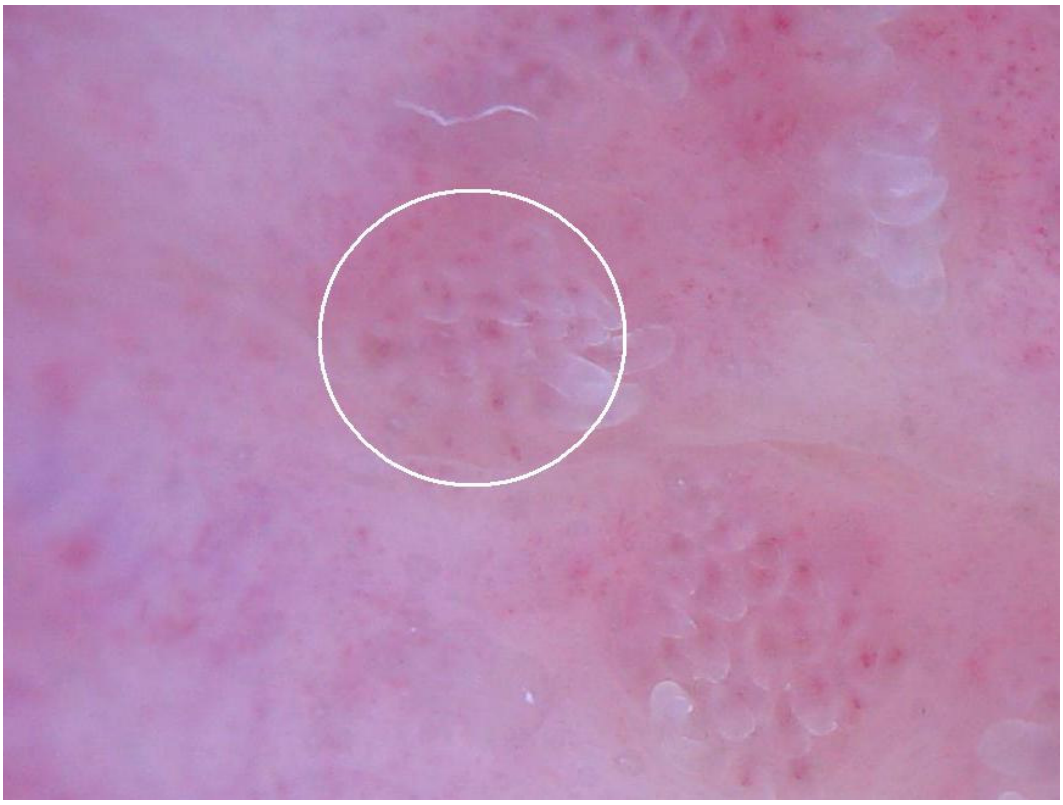

Figure 10. Pomegranate vessels in the center of the exophytic papillary units.

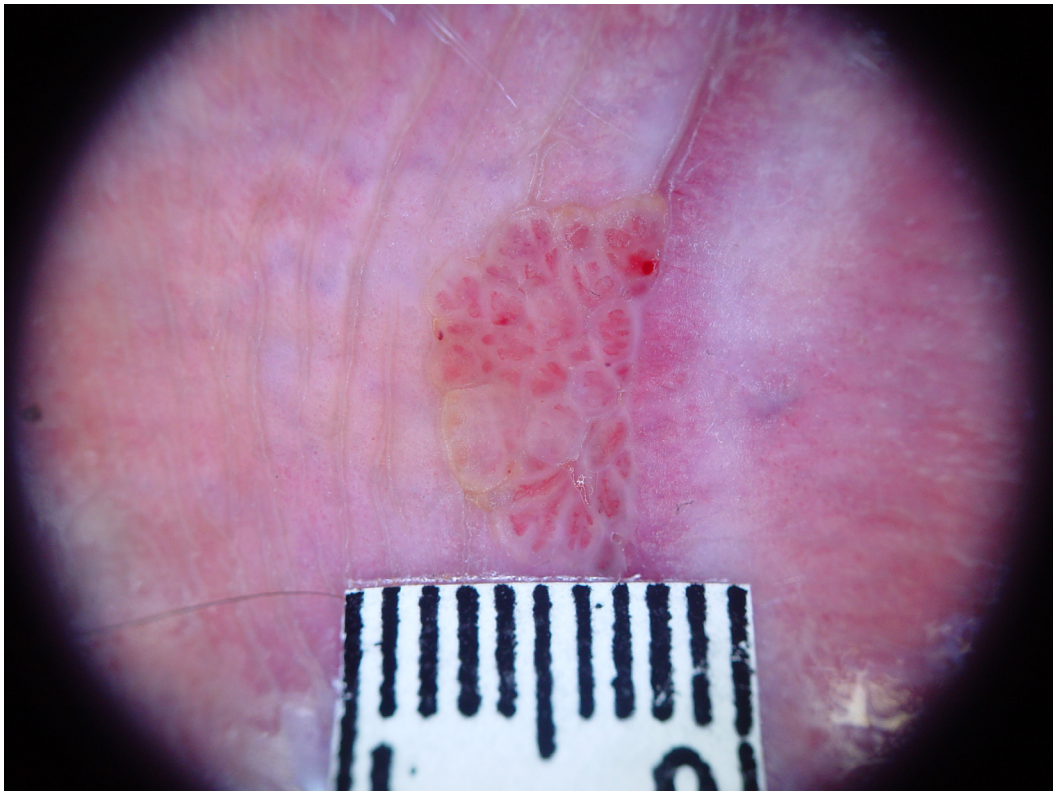

Figure 11. Irregular, pomegranate, and hairpin vessels with homogenous, and gyri and sulci structures.

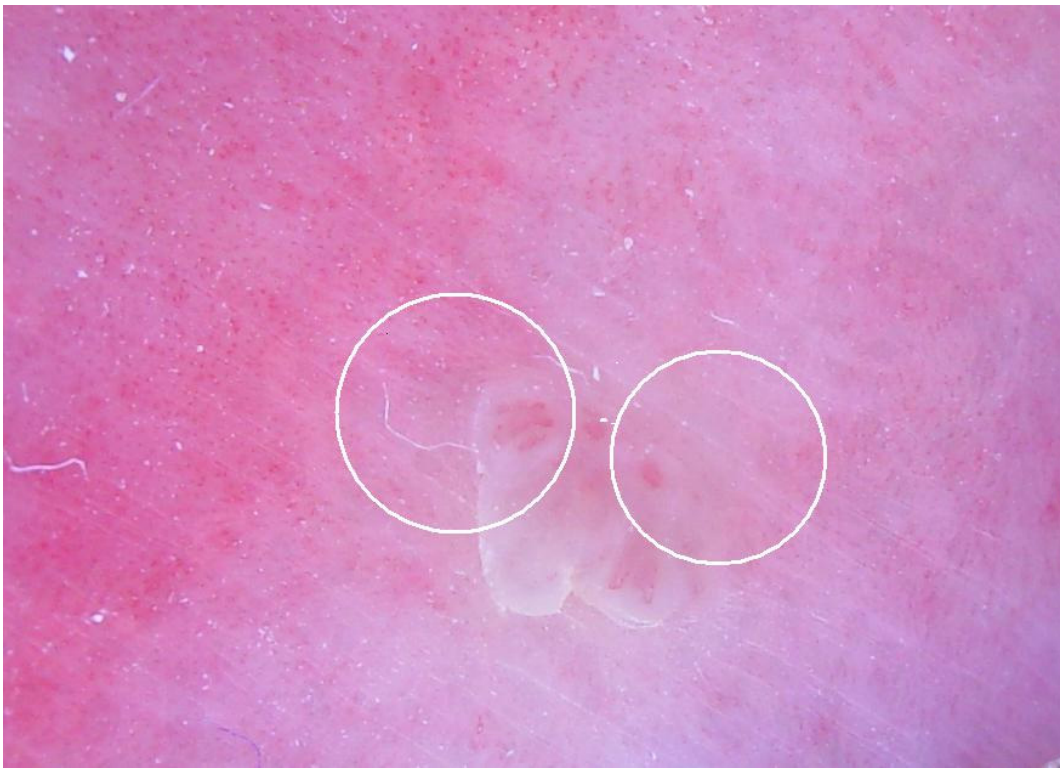

Figure 12. Hairpin vessels and pomegranated vessels in the centers of exophytic papillary units.

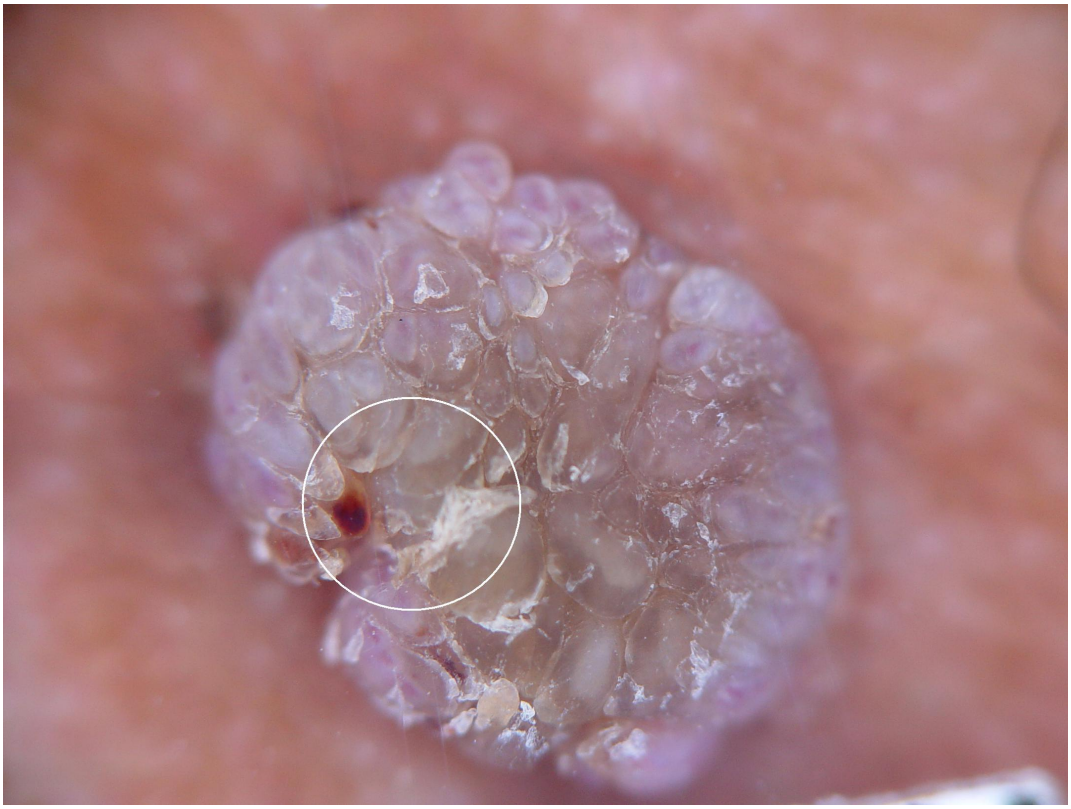

Figure 13. Thrombosed vessel, as well as exophytic papillary structures and yellow-whitish keratotic structures.

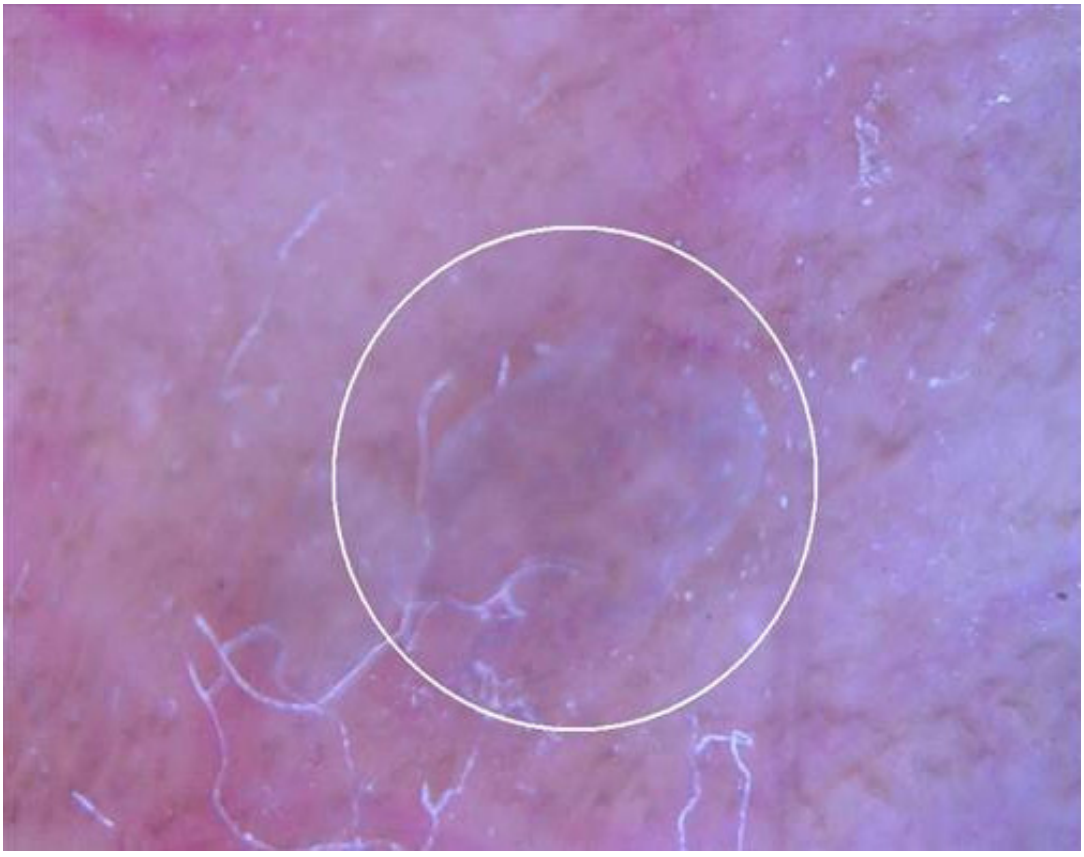

Figure 14. Homogeneous structure.

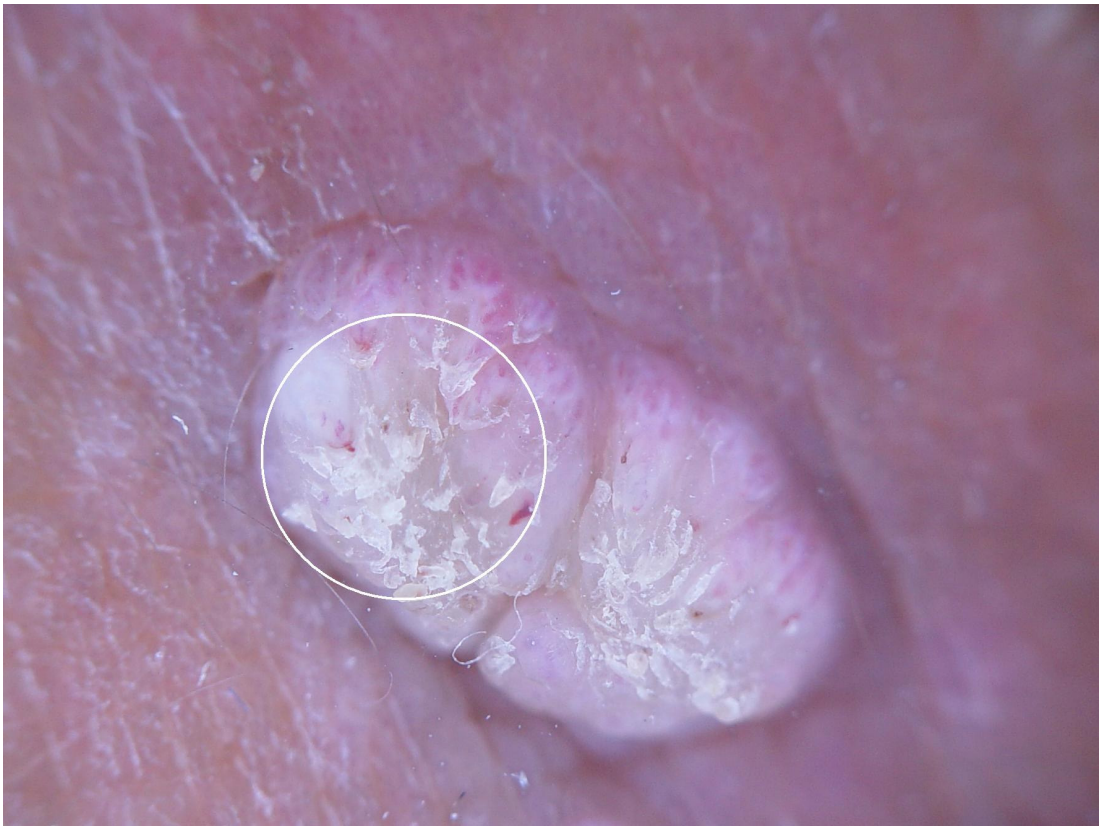

Figure 15. Yellow-whitish keratotic structures, in association with pomegranate, hairpin, and thrombosed vessels in the centers of exophytic papillary units.

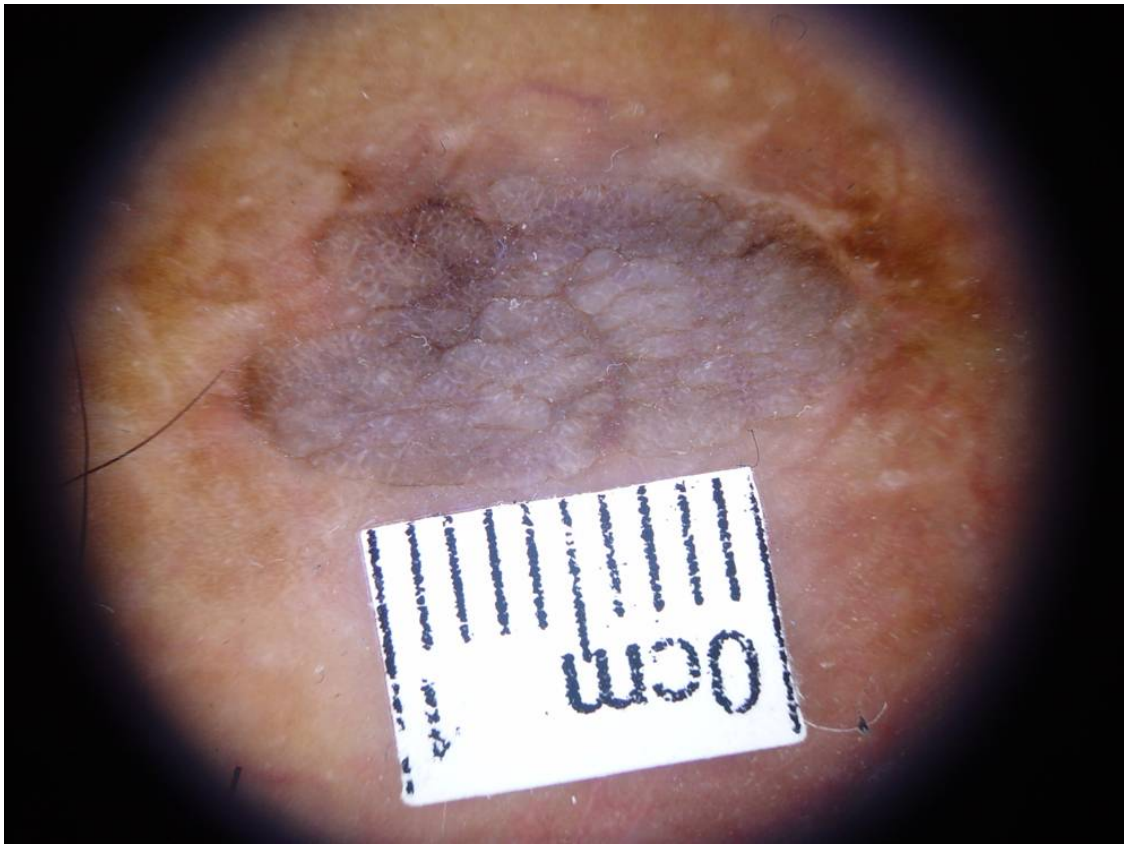

Figure 16. Diffused **pigmentation** with mosaic exophytic papillary structures and gyri and sulci structures.

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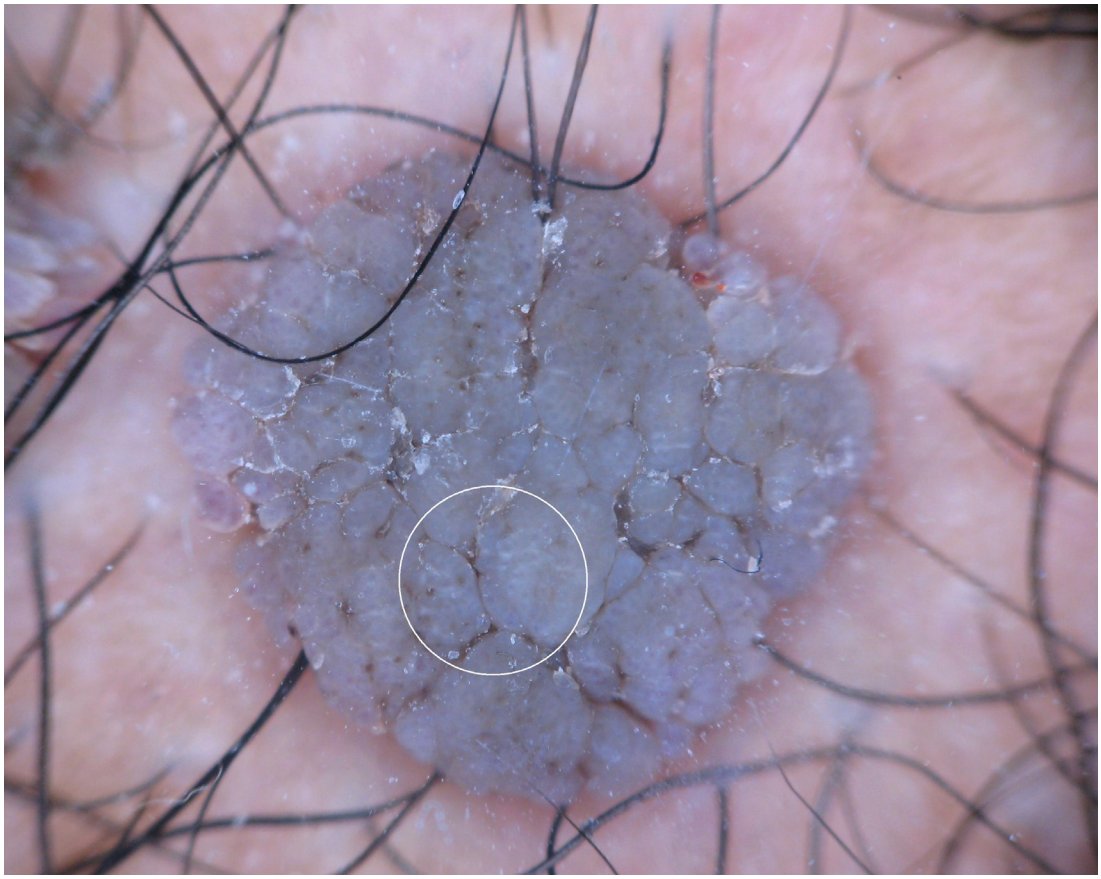

Figure 17. Gyri and sulci structures with diffused pigmentation and yellow-whitish keratotic structures.

3.3 Correlation between Clinical, Dermoscopic, and Dermatopathologic Features

In the 7 lesions of flat warts, which clinically were only slightly elevated, dermatopatholgy showed mild hyperkeratosis and acanthosis in all the 5 lesions with homogenous structure, but without papillomatosis. Mild papillomatosis were presented in both lesions with mosaic exophytic papillary structures. Mild vascular dilation in the papillary dermis was seen dermospathologically in all the 5 lesions with vascular structure under dermoscope. Dermatopathologic hyperpigmentation were seen in all the 3 lesions with pigmentation dermoscopically.

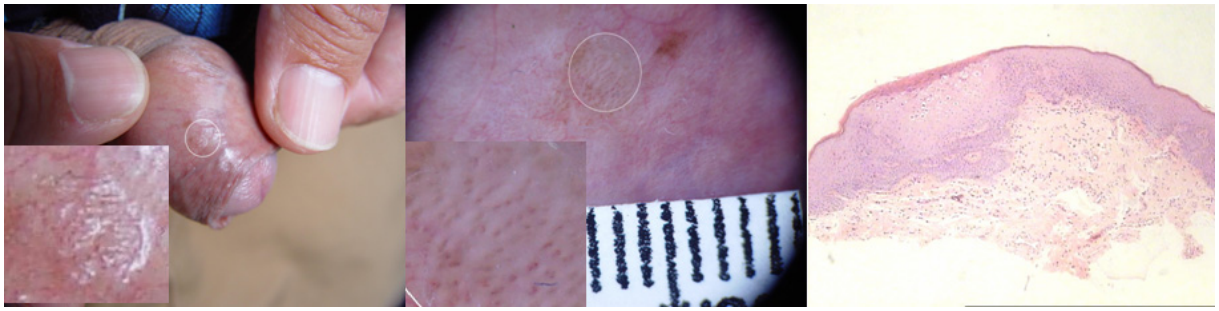

Figure 18-19. Flat warts, clinically were presented as slightly elevated papule; dermoscopically were presented as dotted vessels distributed regularly on the background of homogenous structure; dermatopathologically were presented as mild hyperkeratosis and acanthosis with mild vascular dilation.

The remaining 35 warts, which clinically were more hyperplastic, all displayed exophytic papillary structures dermoscopically and papillomatosis dermatopathologically. The higher exophytic papillary or gyri and sulci structures dermoscopically showed longer papillomatosis dermatopathologically. Markedly dermal vascular dilation was found in

24 lesions among the 25 lesions with dermosciopic vascular patterns. Hyperkeratosis and parakeratosis were presented in 12 and 8 lesions among the 14 lesions with yellow-whitish keratotic structures, respectively. Dermatopathological hyperpigmentation was seen in all the 8 lesions with pigmentation dermoscopically.

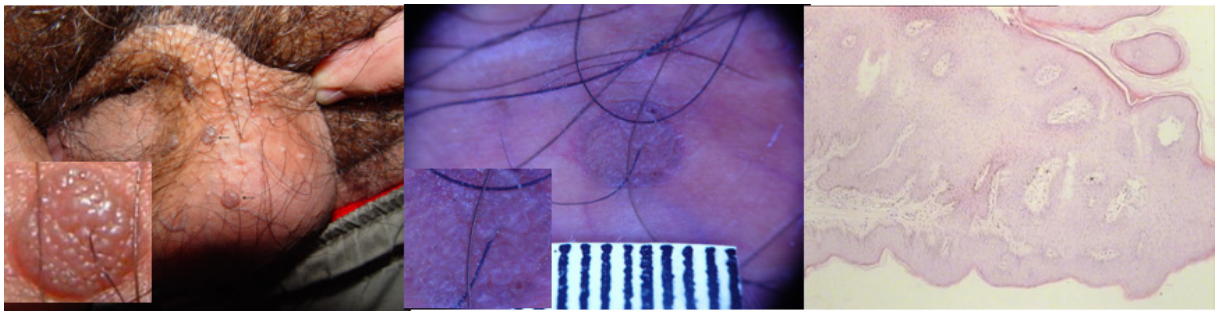

Figure 20-21. Smooth papular warts appeared as smooth, circumscribed, elevated lesions clinically; dermoscopically were presented as mosaic exophytic papillary structures; and dermatopathologically were presented as moderate hyperkeratosis, acanthosis, and papillomatosis. Although in this case, dermoscopically vascular structures were not be able to be seen, but dermatopathologically vascular dilation was present.

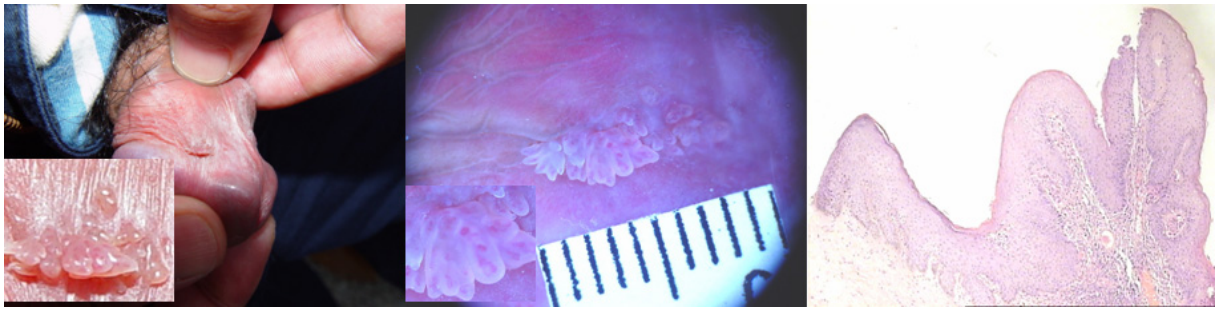

Figure 22-23. Classical pointed warts were soft, fleshy, and vascular, often with multiple small finger-like projections; dermoscopy showed finger-like exophytic papillary structures, with pomegranate and hairpin vessels in the exophytic papillary units; dermapathology displayed marked papillomatosis and dilation of blood vessels in the papillary dermis, but without hyperkeratosis.

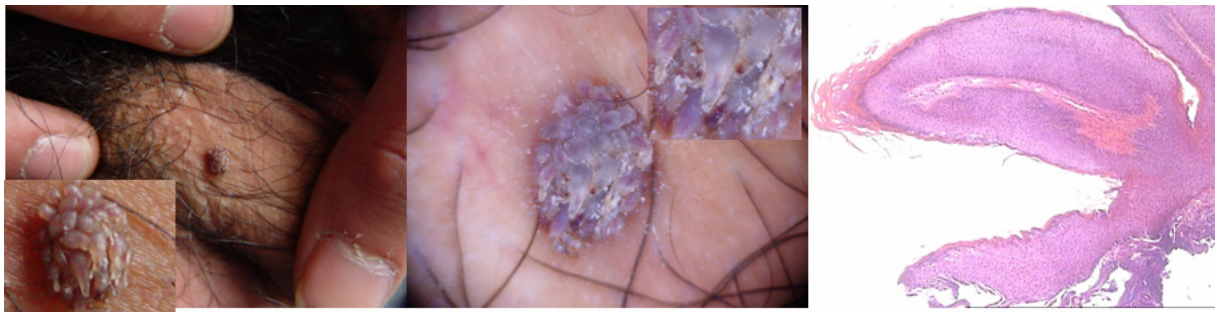

Figure 24-26. Keratotic warts clinically were identical with common warts; dermoscopic features included finger-like exophytic papillary structures, pomegranate, hairpin, and thrombosed vessels, as well as yellow-whitish keratotic structures; dermatopathologic features consisted of marked hyperkeratosis, papillomatosis, and dilation of blood vessels in the dermal papillary.

3.4 Frequency of Dermoscopic Structures Concordantly Identified in Primary and Remote Evaluation of the 42 Lesions

The frequency of dermoscopic structures concordantly identified in primary and remote evaluation of the 42 lesions of genital Warts ranged from 36.4% in irregular vascular structures to 100% in yellow-whitish keratotic structures (average 72.3%). The frequency

of dermoscopic structures only observed in primary evaluation ranged from 0% in mosaic exophytic papillary structures and yellow-whitish keratotic structures to 63.6% in irregular vascular structures (average 15.5%). The frequency of dermoscopic structures only identified in remote evaluation ranged from 0% in homogenous structures, mosaic exophytic papillary structures, irregular vascular structures, and yellow-whitish keratotic structures to 41.7% in thrombosed structures (12.2%) (see table 3).

Table 3. Frequencies of dermoscopic structures concordantly identified in primary and remote evaluation of the 42 lesions in genital warts

Dermoscopic structures	Dermoscopic structures concordantly Identified in primary and remote evaluation N(%)	Dermoscopic structures identified only in primary evaluation N(%)	Dermoscopic structures identified only in remote evaluation N(%)	Total N(%)
Homogenous	11(84.6)	2(15.4)	0(0)	13(100)
Exophytic papillary				
Mosaic	12(70.6)	5(29.4)	0(0)	17(100)
Finger-like	9(81.8)	0(0)	2(18.2)	11(100)
Mixed	6(54.5)	1(9.1)	4(36.4)	11(100)
Vascular				
Dotted-pomegranate	26(92.9)	1(3.6)	1(3.6)	28(100)
Irregular	4(36.4)	7(63.6)	0(0)	11(100)
Hairpin	8(80.0)	1(10.0)	1(10.0)	10(100)
Thrombosed	5(41.7)	2(16.7)	5(41.7)	12(100)
Yellow-whitish keratotic	14(100)	0(0)	0(0)	14(100)
Pigmentation	8(61.5)	2(15.4)	3(23.1)	13(100)
Gyri and sulci	4(50.0)	2(25.0)	2(25.0)	8(100)
Average	107(72.3)	23(15.5)	18(12.2)	

Data are n(%).

4 Discussions

We only recruited male patients with genital warts for study, because it is not convenient to take dermoscopic images in female patients due to the anatomic structures of the female genital area and it is difficult to persuade the female to participate in our study. Furthermore there is no evidence that there are significant clinical differences between male and female genital warts.

To guarantee the quality of our study, we used teledermatology as a tool. The dermatopathologically controversial lesions were submitted at http://www.telederm.org for second opinion from Soyer HP. The dermoscopic structures of the 42 lesions were primarily evaluated by Shu D and Dong H, and then were further evaluated Hofmann-Wellenhof R remotely. The concordance in identifying dermoscopic structures between primary and further evaluation ranged from 36.4% in irregular vascular structures to 100% in yellow-whitish keratotic structures (average 72.3%).

Our results indicate that genital warts had distinct dermoscopic features. The main dermoscopic features of genital warts were exophytic papillary structures and vascular structures. Exophytic papillary structures could be mosaic, finger-like, or mixed patterns, which were found in nearly a similar frequency in genital warts. Exophytic papillary structures were composed of tightly arranged exophytic papillary units, which were similar in diameter, but might be different in length. Usually the vascular structures were located in each exophytic papillary unit. Vascular structures could be dotted vessels, pomegranate vessels, irregular vessels, hairpin vessels, and thrombosed vessels,

among which pomegranate vessels were most common. The other dermoscopic features presented in genital warts were homogenous structures, pigmentations, and gyri and sulci structures. Each of the 4 subtypes of genital warts has its own characteristics.

Our results also indicate that there were close correlations between the clinical, dermoscopic, and dermatopathologic features in genital warts.

Concerning correlation between clinical features and dermoscopic structures, flat warts clinically were only slightly elevated. Dermoscopically they showed mainly homogenous structures, and dotted and pomegranate vessels.

Smooth papular warts clinically were papules with smooth surface. Dermoscopically they showed predominantly mosaic exophytic papillary structures and pomegranate vessels.

Classic pointed warts were fleshy, vascular, and had finger-like projections. Dermoscopically exophytic papillary structures and vascular structures are generally present. Finger-like and mixed exophytic papillary structures were the exophytic papillary structures predominantly present in this group. Hairpin vessels were only found in longer exophytic papillary units. Nevertheless, hairpin vessels were present in this group most frequently.

Keratotic warts clinically mimic common warts, which were dry, keratotic, and had verrucous appearances. Finger-like and mixed exophytic papillary structures and yellow-whitish keratotic structures were main dermoscopic manifestations in this group. Vascular structures were observed less due to overlying thickened keratotic structures.

In regard of dermoscopic and dermatopathologc correlations, dermoscopic homogenous structures corresponded to mild dermatopathologic hyperkeratosis and acanthosis, but without papillomatosis. Exophytic papillary structures and gyri and sulci structures corresponded to papillomatosis dermatopathologically. The higher the exophytic papillary or gyri and sulci structures dermoscopically, the longer the papillomatosis dermatopathologically. Vascular structures corresponded to vascular dilation in papillary dermis. In dotted vessels and pomegranate vessels, the vascular dilation was less prominent; whereas, in irregular and hairpin vessels, the vascular dilation was more evident. Yellow-whitish keratotic pattern corresponded to hyperkeratosis and parakeratosis. Pigmentation under dermoscope corresponded to hyperpigmentation under microscope.

Zalaudek et al described their primary experience in dermoscopy of genital warts recently. They found that genital warts show a mosaic pattern consisting of a white reticular network surrounding central small islands of unaffected mucosal skin. [27] We did find the mosaic pattern in our study, but dermoscopy of genital warts has far more patterns. Dermoscopy of genital warts share some features with other warts due to human papillomavirus infections. All of them show dotted vessels, which correspond histopathologically to the apices of capillaries in the papillary dermis. Red, brown, or black hemorrhagic dots and streaks are found in common warts and plantar warts. [27] In our study, we also found similar manifestation in genital warts, but we designate them as thrombosed vessels. The larger dotted vessels in common warts described by Teoli M et al [30] correspond to the pomegranate vessels in our study. It is not surprising that all the warts have shared dermoscopic features. However, we found other dermoscopic

structures in genital warts, namely irregular vessel, hairpin vessel, homogenous structures, pigmentation, and gyri and sulci structures.

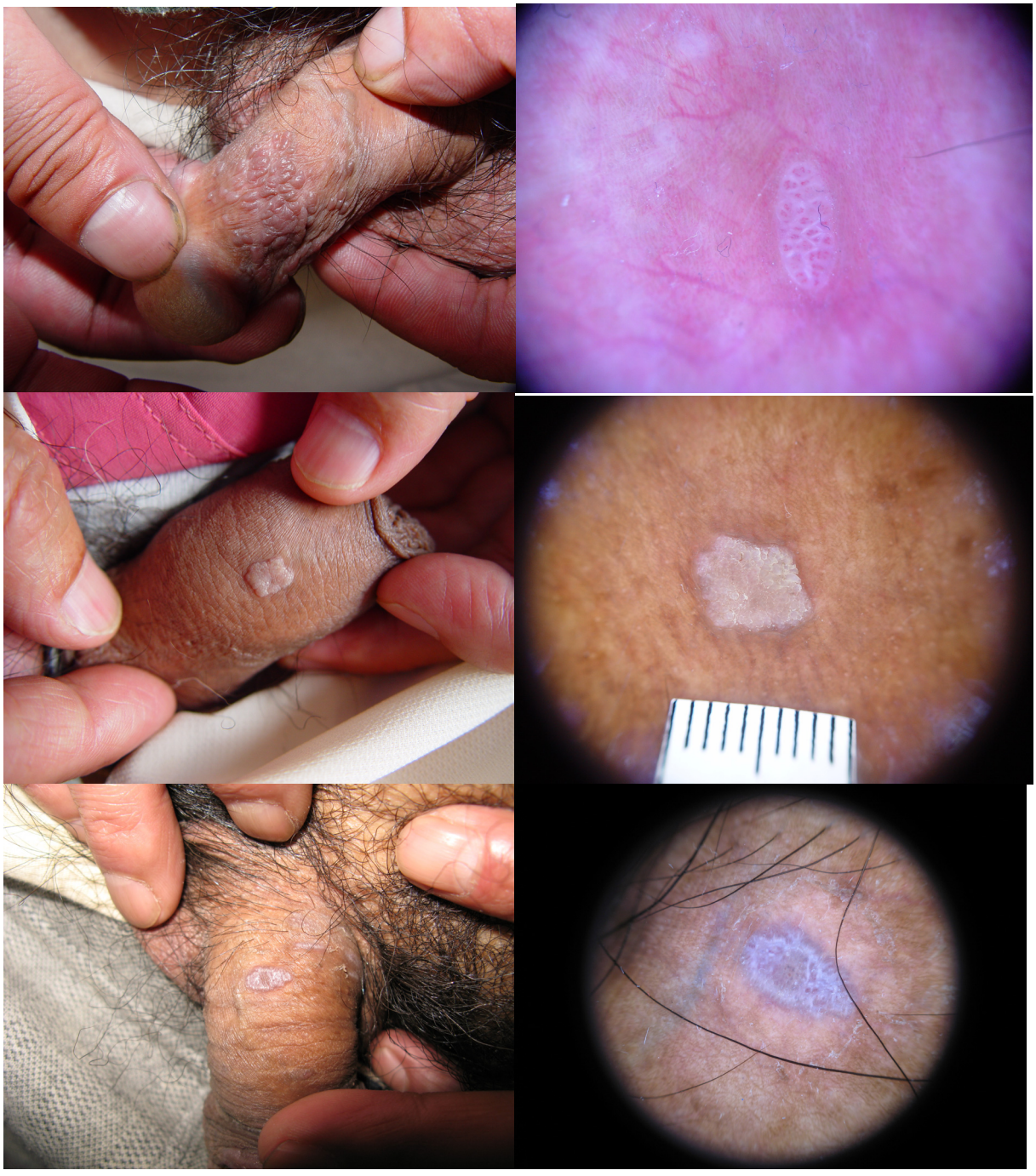

Figure 27-32. Smooth papular genital warts clinically are difficult to be differentiated from lichen planus. But both conditions have different dermoscopic features. Figures 28 shows mosaic structures and pomegranate vessels in a lesion of smooth papular genital warts. Figures 30 shows mixed exophytic papillary structures and yellow-whitish keratotic structures in a lesion of another patient with smooth popular genital warts. Whereas figure 32 shows whitish striae in a lesion of lichen planus located on the back of penis.

Genital warts usually can be diagnosed clinically. However, flat warts are difficult to be diagnosed clinically, and even difficult to be seen with naked eye. Other subtypes of genital warts should be differentiated from seborrheic keratosis, lichen planus, bowenoid papulosis, condylomata lata, and erythroplasia of Queyrat.

Our results shows flat warts usually have dermoscopic features of dotted or

pomegranate vessels on a background of white or grey homogenous structures. These dermoscopic features enable dermatologists to diagnosis flat warts more confidently. These findings may be also useful in deciding the treatment field in the treatment of genital warts.

Genital warts may share similar clinical features with seborrheic keratosis, including papillomatous and hyperkeratotic surface, and hyperpigmentation. According to Soyer HP et al [24, 25] and our present findings, they even share some similar dermoscopic features, namely, exophytic papillary structures, gyri and sulci structures, hairpin and dotted vessels, yellow-whitish keratotic structures, and pigmentation. However, the main dermoscopic features of genital warts are exophytic papillary structures and vascular structures located in the centers of the papillary units. The exophytic papillary structures in genital warts are composed of tightly arranged exophytic papillary units in similar diameters, despite that they may be different in length.

Clinically, smooth popular genital warts should be differentiated from lichen planus, because lesions in both conditions are flat papules. The hallmark of dermoscopic feature of lichen planus is pearly whitish striae. The pearly whitish striae correspond to Wickham striae, which are pathognomonic for lichen planus. [31-33] This dermoscopic feature of lichen planus allows for the differential diagnosis between lichen planus and smooth papular genital warts easily (see figure 27-32).

Up to now, there are still no descriptions about dermoscopy of Bowenoid papulosis, condylomata lata, and erythroplasia of Queyrat. However, genital warts, Bowenoid papulosis, and erythroplasia of Queyrat have different features in dermatopathology. Usually there is correlation between the dermoscopic features and dermatopathologic features in skin diseases. [24, 34] Therefore, we presume that dermoscopy may also helpful in differential diagnosis in these three conditions, which desires evidence from researches in the future.

Although the role of dermoscopy in the diagnosis and differential diagnosis of genital warts is limited, dermoscopy is non-invasive and convenient, when it is compared with other laboratory examinations in the diagnosis and differential diagnosis of this disease.

5 Conclusions

Dermoscopy of genital warts is useful in diagnosis of flat warts, and in differential diagnosis of genital warts from seborrheic keratosis, lichen planus. Further researches in dermoscopy of Bowenoid papulosis, condylomata lata, and erythroplasia of Queyrat are indicated, in order to find the possibility of differentiating genital warts from these diseases dermoscopically. Teledermatology is a valuable tool in collaborative research.

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