TELEMEDICINE IN ORTHODONTICS: THE REMOTIZATION OF ORTHODONTIC RECORDS FOR DIAGNOSIS AND THERAPY

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Abstract

Objective: Aim of this study was to assess the effectiveness of Dental Centers connected to each other managing orthodontic records. The secondary aim was to carry out epidemiological studies and to evaluate their compliance with local health policies.

Methods: Cloud Computing Technology and Video chat systems were used. Epidemiologic data from four orthodontic Centers were collected. Prevalence of the skeletal class and the IOTN (Index of Orthodontic Treatment Need) were determined.

Results: Tele epidemiology provided a sample of 1501 patients. 7% presented skeletal class III and 36 % skeletal class II. The IOTN Index was grater in Clinic of Monza and Bergamo than the other Centers.

Conclusions: Cloud and Video chat systems are fundamental tools for improving efficiency in Tele Orthodontics. Epidemiological studies are useful for manage the Dental Centers and for planning health policies regarding prevention, education and economic support.

Keywords: Tele Orthodontics, Cloud Computing, Digital Orthontic Records, Iotn Index, Health Policies

Introduction:

Tele Orthodontics is a part of Tele Medicine: it is defined as the set of orthodontic techniques and information for remote care of patient (Ministry of Health,2012). It is necessary that all data are transferred in

digital format for its realization. Furthermore it needs an internet connection between the Dental Centers involved. The healthcare advantage of using telemedicine in orthodontics is easy file sharing and managment of the orthodontic activities in the whole territory, in accordance with guidelines established by a Headquarters, in this case the Dental School at the University of Milan-Bicocca. The citizen pertaining to peripheral offices receives the same level of service of the clinic of Monza. Furthermore even the management of human and economic resources can be optimized (Chaudhry B, 2006).

Telemedicine in Orthodontic is useful for diagnosis, counseling, therapy and epidemiology. It is evident that, in addition to health-care and educational fields, Tele orthodontic is useful in managerial aspects and research (Häyrinen K,2008).

One of the obstacle for the proper development of Tele orthodontics is the complex diagnostic system based on the analysis of orthodontic records.

To overcome this problem, the digitalization process of the records has simplified their management and transmission (Hillestad, R.2005, Blanchet, K. D 2008, Yellowlees, P. M 2008). The photos are stored directly from the device into the computer. The radiographs are in digital format thanks to the use of storage phosphor plate systems and digital sensors. Tweed models are 3D scanned and transferred by alphanumeric codes on the monitor of the users. These records are essential for the correct diagnosis because they can properly assess the parameters of the skeletal and soft tissue morphology of the patient (Hillestad, R.2005, Blanchet, K. D 2008, Yellowlees, P. M 2008).

The ORAOT (Organization Network of Dental Activity on the Territory) is crucial in order to achieve the objectives of the research. This is a group of Dental Centers distributed uniformly over the whole territory of Milano-Bicocca connected together with an interactive and multimedia way at the headquarters at Monza San Gerardo Hospital. The institutionalization of this organization allows to coordinate homogeneously orthodontic activities in the area, focusing not only the scope of care treatment, but also in educational, research and management.

The Cloud is a set of technologies (hardware and software) given by a provider that allows users to store/process and share data directly online, without reducing the power and memory storage of peripheral computer George Reese 2010, Furth, B 2010). The National Institute of Standards and Technology (NIST) identifies the Cloud system with five features, three service models and four models of issue. (Fig 1)

The Public Cloud are infrastructures owned by a specialist provider that makes available the systems to its users (computer applications, processing power and storage) (Furth, B 2010).

Data is not storage on user's "physical" local server, but user outsource all data on provider's remote servers. You can easily deploy and upgrade the services acquired by the provider (for example increased need for data storage). In the SaaS model (Software as a Service Cloud - Cloud of software delivered as a service) the provider delivers web application services by placing them available to end users (Furth, B 2010). Since the data can be shared among many users, it is essential to establish an appropriate level of security (Furth, B 2010). The provider of the data storage systems can provide an additional safety mechanism with a secure encrypted protocols (decision taken based on the criticality of health data) (Furth, B 2010).

Our aim in this study is to assess the effectiveness of the remote management of orthodontic records in diagnosis, therapy, counseling and epidemiology in different Dental Centers remotely connected to each others. The secondary aim is to carry out epidemiological studies with the collected data and to evaluate their compliance with establish health policies.

Methods

The pedo-orthodontic departments belonging to ORAOT who participated in the study were the "Policlinico di Monza" of Verano Brianza (Monza), the "Azienda Bolognini Seriate" of Alzano Lombardo (Bergamo), the Dental Clinic of Monza (HQ) and the "Centro Odontostomatologico Don Orione" (Bergamo).

The Cloud solution adopted to connect the headquarters of ORAOT with the local Centers is a Public Cloud with a SaaS service model.

The use of this service is via the Internet network.

The solution adopted in this study will ensure the safety of data transmission thanks to a secure mechanism based on username and password identification that allows all Centers to access at the same database of information.

The data of all patients are stored neatly by the doctors in medical records according to the location of the patient's registration. Information is easily uploaded and displayed regardless of the weight of the files making the communication and the management more efficient (Fig 2). All the therapeutic questions from the peripheral Centers as well as the therapeutic proposals of the headquarters are collected in the folder of comments, in chronological order. The data storage is stable, this means that once entered can not be modified. Simultaneously with the display of patient data, operators can consult each other in real time through chat and

videoconferencing systems (Fig 3) allowing an exchange of knowledge and opinions with specialists. The basic tools provided for each multimedia station are a webcam, video conferencing software, a microphone and two speakers. According to this method, the connected users are able to listen to and to talk through the microphone and speakers, while they can see each other through the computer monitor.

Results

Thanks to Tele-orthodontics, multimedia connections made in 2011 were quantified in the Tele diagnosis, Tele counseling, Tele therapy and Tele epidemiology. The requests of patients without special needs aged 6 to 16 years were taken into consideration. Table 1 shows the percentage of benefits obtained. In a total of 2365 performance, 354 connections have been made for the Tele diagnosis, 322 for Tele counseling, 188 for the Tele therapy and 1501 for the Tele epidemiology.

Afterward it was analyzed the prevalence of skeletal classes in the sample taken from Tele epidemiology. The angle ANB, that defines sagittal relations between the two jaws, was used as reference value. Normal values, indicative of a skeletal Class I, are 2 ° ± 2 °, while values increased or decreased, respectively, are indicative of a skeletal Class II and III. Table 2 shows that in the sample of 1501 patients, 856 patients present Class I skeletal intermaxillary relationships (57%), 540 patients have Class II skeletal intermaxillary relationships (36%) and 105 patients Class III skeletal intermaxillary relationships (7%).

Thereafter, the distribution of gravity IOTN index for each of the sites examined was evaluated in the sample of 1501 patients. Data were grouped according to whether IONTN index were lower than / equal to 3 and greater than 3. Table 3 shows that Verano presents 16 cases with IOTN> 3 and 30 cases with IOTN <3, Monza 27 cases with IOTN> 3 and 63 cases with IOTN <3, Alzano 12 cases with IOTN> 3 and 36 cases IOTN <3, and finally Don Orion shows 28 cases with IOTN> 3 and 70 cases with IOTN <3.

Discussion

The networking is a prerequisite for enabling the delivery of uniform performance to patients belonging to Centers distant from the main office, but also to coordinate the departments in accord with scientific criteria and to improve the exchanges of information. This system allows healthcare professionals of the Centers to consult each other in order to provide the best possible treatment to the patient. In addition, the networking will allow the transfer of data quickly, safely and efficiently. The aim is to upgrade the

health system, deciding to take advantage of Cloud Computing technology in order to improve its performance (Chaudhry B,2006).

The Cloud could increase the quality of health care patient treatment by reducing therapeutic errors and costs and by simplifying management, storing and assessing data of the patient (Hargreaves, J 2010, Chen, Y 2012). Even the software for processing digital models, or the radiographs are storage in the Cloud saving the hard disk memory of the local clinical computer (Pandey, S, 2011). The software was developed specifically to improve the efficiency of the clinical orthodontic activity. The calculation of the values of the routes and occlusograms is done automatically by the software when data are uploaded, avoiding to perform this procedure for each individual patient and saving further time.

The innovation of Cloud lies mainly in the rationalization of costs because, being all services supplied directly from the provider it reduces hardware and software and no longer has to take care of the management of maintenance and updating of systems(Chaudhry B,2006, Shekelle PG 2006). However, further studies are needed to quantify the increase in the quality of clinical care and cost containment(Chaudhry B,2006, Donald C2009).

The increase in the number of services performed in 2012, compared with multimedia connections made in previous years (Graph. 1), shows that the ORAOT, Cloud and videoconferencing have allowed the improvement of connections between offices over time. The system has proven effective and efficient, making it more practical and encouraging the use of Tele-orthodontics in the fields surveyed, the number materialized in increasing performance.

If the connections made by other departments are included in the evaluation, for example the departments of Surgical Sciences and Sciences Oral Hygiene (Graph. 2), an evident increase in the total number of ORAOT performance is observed, as further confirmation that these tools are essential for the optimum efficiency of Tele Transmission.

Epidemiological surveys allow to better investment of human and economic resources, by indicating the different distribution of orthodontic problems in the territory. It is evident that this eases the management of ORAOT's activities.

Epidemiological surveys are also useful to assist the planning of preventive health policies, as well as those for education and support of research and innovation.

For the future it is advanced to broaden the sample for epidemiological analysis and to monitor the distribution of pedo-orthodontic diseases to accommodate the health policies.

It is proposed to involve other university centers to create a common database where data of all patients could be stored in order to make possible

scientifically relevant randomized controlled trials (RCT). It is hoped to conduct the cost analysis to maximize the spread of the orthodontic treatment with the order not to aggravate the health care spending, by involving the citizens in the expenditure and adjusting resources already allocated for Orthodontics, so as to treat those most in need. Finally it is planned to foster the collaboration between the ORAOT territory and local health facilities to provide useful and new directions in health care delivery and management.

Conclusion
      Cloud and Video chat systems are fundamental tools for improving efficiency in Tele Orthodontics. Epidemiological studies are useful for the management of the Dental Centers and for planning health policies regarding prevention, education and economic support.

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