In the name of God

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Shiraz University of Medical Sciences

School of Dental Medicine

THESIS

For D.M.D. Degree

CRYOSURGERY IN DENTISTRY

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Tir 1369

بسمه تعالـــــی

ارزیابـی پایـــان نامـــه

پایان نامه شماره ..... تحت عنوان cryo surgery in dentistry

تهیه شده توسط عبدالهادی مصلی نژاد در کمیته بررسی پایان نامه مطرح وبـــا

درجه/نمره ..... به تصویب رسید .

۱۸٫۵ هجده و پنج

استاد راهنما دکتر سید محمدرضا کازرونیان سمت ..... امضاء

امضاء اعضاء کمیته بررسی :

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تقدیم به :

تمام مبارزان وشهیدان ومعلولین واسرای راه حق و آزادی ازصدراسلام تاکنون .

و

تمامی آنهاکه به من علم آموختند وراهنمای من درطول دوران تحصیلم بودند .

و

پدر ومادرم که درپیشرفت من درراه علم ومعرفت ازهیچ کوششی دریغ ننمودند وهمواره مشوق وراهنمای من بودند .

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History and Introduction :

I- Use of Cold in Medicine :

Cryogenics is the science and technology of producing and using very low temperatures. The study of low temperature effects in biology and medicine is called cryobiology. It is active research area.The first successfull recorded attempt to cool air for air coditinning took place in 1840. John Gorrie, a physician in florida, was trying to relieve the suffering of malaria patients by cooling their room , the succeeded in making ice by using the cooling effect of expanding air.

Following Gorrie's success a number of achievements were made in liquefying gases, liquid air (- 96 C) was produced in 1877; liquid helium (-269 C) was produced in 1908.[46,47,49]

Low temperatures have been used for long term preservation of blood, sperm, bone marrow and tissues. Much interest has been aroused by the idea of using cryogenic method to cool the body into a state of "suspended animation" so that it can pass time without aging. This "science" is called cryonics.One goal of cryonics is to preserve at low temperature people with fatal diseases with the hope that in the future they could be revived and their diseases cured.[22,23,46,47]

Another important finding involves the freeze-thaw cycle. Survival after freezing is more dependent upon the cooling rate during the

freezing cycle than on the warming rate during the thawing cycle. The survival curves of different biomaterials as a function of cooling rate have similar shapes , but there is no unique cooling rate that will ensure cell survival for all materials. This puts a severe limitation on preserving biomaterials composed of many different cell types. For many mammalian cells only a few percent survive, thus freezing and thawing offers little hope as a general means of long term biological storage.[14,23,46]

II- Cryosurgery in Medicine and Dentistry :

Cryosurgery (from the Greek Kryos, meaning icy cold, plus surgery) or cryogenic surgery, refers to surgery accomplished through application of intense cold to cause tissue necrosis (cryonecrosis) by rapid freezing. Almost 300 years ago Robert Boyle observed that freezing of tissue produced necrosis (Parks, 1957).[39,45,46]

The unique properties of cryosurgery were recognized before the turn of this century and have become more fully appreciated in the dozen years since cooper (1961,1963) reported the development of a reliable liquid nitrogen system.[36,46,49]

More recent investigators demonstrated that when tissue is frozen and thawed, some cells can survive. (Leibo et al 1970 and Luyet 1968) More ever, certain cell types have differing susceptibilities to the

effects of freezing (Asahind 1967). In general, less cellular tissues like sclera or scar tissue are less susceptible to necrosis from freezing. Lower temperatures are also required to produce necrosis in vascular and connective tissues than in epithelial tissues. Other factors that influence the amount of tissue damage are the rate of cooling , the final temperature reached, the time spent in the frozen state,the rate of thawing and medium in which these take place.[39,46,47]

Reason for cell death after freezing remains some what controversial, Meryman (1960) believes that freezing has two principal effects on tissue which cause cellular injury and subsequent death. First, the cellular metabolic rate is changed into ice. He concludes that injury from temperature reduction alone is due to dislocation of the metabolic production line and cannot in the strictest sense be ascribed to any direct effect of reduced temperature.

Therefore, the events that are involved in cellular necrosis during freezing are formation of extracellular ice to cell membrane damage, formation of intracellular ice and cell death.[14,22,39,46]

Liquid air, liquid oxygen , carbon dioxide snow and liquid nitrogen have been used as cryogens for years. More recently, carbon dioxide gas, freon, and nitrous oxide have been preferred by limited number of physicians . Because of availability and safety, as well as for other reasons Carbon dioxide snow and liquid nitrogen are most

frequently used today. Liquid nitrogen can be used to achieve temperature of -196 C. Other cryogens such as carbon dioxide and freon may reach temperatures of -20 C to - 89 C depending on the apparatus. [4,22,39,46,47]

Obviously, the time necessary for the probe to be in contact with the tissue to be destroyed depends on the minimum temperature reached as well as the size of the lesion and the type of tissue. According to Poswillo (1971), most tissue freeze at -2.2 C, However, Cahan (1965) recommends using a temperature of at least -20 C to ensure necrosis, Generally, 4 to 5 minutes of freezing at -80 C will result in sufficient tissue necrosis to eradicate must intraoral mucosal lesions.[22,46]

Cryosurgery has several advantages : 1- There is little bleeding in the destroyed area , 2- The volume of tissue destroyed can be controlled by the temperature of the cryosurgery probe and 3- There is little pain sensation because low temperatures tend to desensitize the nerves. Cryosurgery has been used for vari ty of clinical conditions, one of the first uses of cryosurgery was in the treatment of parkinson's disease, parkinson's disease causes uncontrolled tremors in the arms and legs, it is possible to stop the tremors by surgically destroying the part of the thalamus in the brain that controls the transmission of nerve impulses to other parts of the nervous system. Also, that has been used for treatment of brain tumors, vascular anomalies

(hemangiomas), epilepsy. Cataracts and other occlular problems, mucous membrane tumors and other neoplasms, intraosseous tumors, ameloblastoma and aneurysmal bone cysts.[22,26,46]

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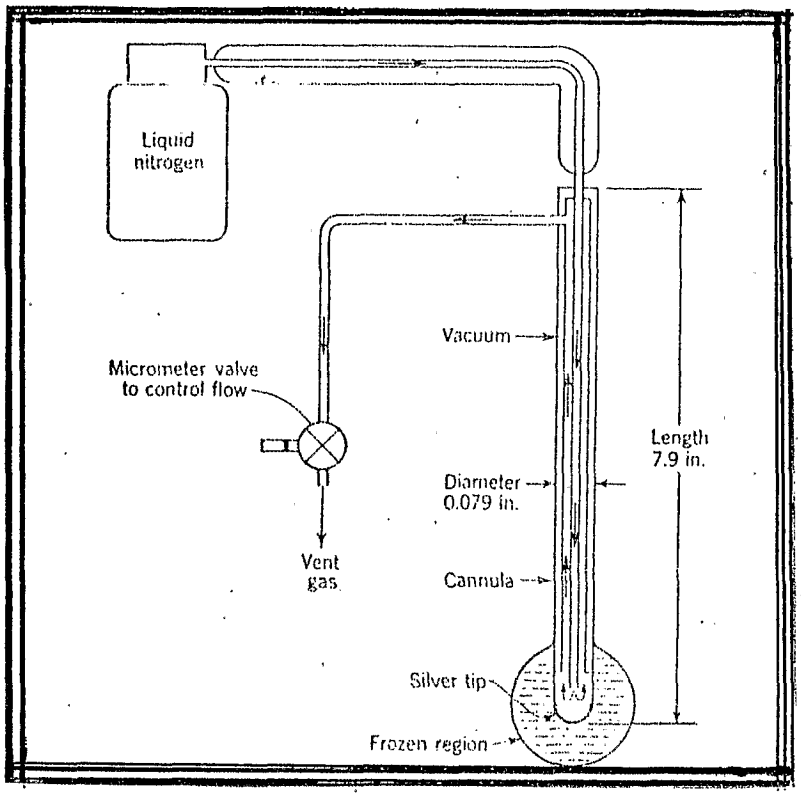

Fig. 1. Cooper cryosurgery system

Review of Literature :

The effects of the application of extreme cold to the oral soft tissues are now well documented and numerous topics and papers are found about cryosurgery of oral tissues and its effects.

In 1970 Cherry and Tem showed that cryotherapy may prove to have certain advantages over other modalities, it is safe, painless, and can be used without anesthesia on an outpatient basis.[31]

Cryosurgical treatment of two hemangiomas proved to be functionally and cosmetically successful by the work of Henderson and Houston (1971). The reduction in the size of the lesions after were cosmetically acceptable to the patient.[25]

The mechanism of tissue destruction by cryosurgery were described by Leopard and Poswillo. (1974) . They showed that in the management of premalignant oral lesions, cryosurgery is considered to be of particular importance, whereas its place in the primary treatment of established malignant conditions is less certain.[23]

Bradley in 1975 described the histological response of bone to freezing and suggested that there are three overlapping phases:necrotic, osteogenic and remodelling.[22]

Webster and Reid in 1976 reported the problems following cryotherapy for oral cancer. Three patients treated unsuccessfully for primary

intra-oral carcinoma by cryotherapy. Possible reasons for the failure were described; the conclusion was made that cryotherapy, unless very carefully controlled, was not the treatment of choice in uncomplicated primary oral concer.[38]

A light microscopic evaluation of major and minor salivary gland was researched by Natiella, Rosa, Bessette and Gage (1979). The minor salivary glands in the hard palate and the submandibular gland were subjected to a liquid nitrogen. The extent of tissue destruction was determined at intervals up to 1 years. Clinically relevant finding resulted and form the basis for subsequent studies.[40]

Experiences gained over three years cryosurgery in stomato-oncology (1979). 277 patients were treated for oral neoplasia and hemangiomas. It was stressed that cryosurgery was especially applicable for treating benign and malignant lesions of the anterior third of the oral cavity where healing was good, complications few, and inspection fairly easy.(1979)

The effects of cryotherapy on widespread leuko plakia of the buccal and vestibular mucosa were observed clinically and studied histologically by Cohen and Lemmer (1982). The treated areas were clinically normal 2 months after treatment, and discomfort and inconvenience of treatment were minimal. The epithelium, which was initially orthokeratinized , with mild dysplasia, and which was almost entirely

lacking in glycogen, reverted to the parakeratinized or non keratinized form, with normal distribution of glycogen in the stratum spinosum.[15]

Treatment of intra oral hemangiomas with nitrous oxide cryosurgery was performed by Gongloff and Calif (1983)

They reported that nitrous oxide cryosurgery, when applied efficiently, is shown to be both effective and consistent in the management of hemangiomas of the oral cavity.[9]

The Role of cryotherapy in the management of oral leukoplakia was investigated by Al-Drouby (1983) and results was good.[43]

Combined cryosurgical, chemotherapeutic, and radiotherapeutic management of T_1 4 NOMO oral cavity cancers were investigated by Airldi, Fazio, Gandolfo, Vercellino, Ozzello, Pendani and Negri (1985) that results was relatively good.[27]

The treatment of an OKC of the mandible with a combination of enucleation and cryosurgery has been presented with a 5-year follow up without recurrence by Webb and Brockband (1984).[28]

A case of oral papillomatosis in a 22- year-old male. is was presented by Aggarwal et al.(1984). This patient had this growth 1.5 years ago and was treated surgically, but the lesion recurred after 6 months. The patient was then treated by cryotherapy and no recurrence was seen 10 mouth later.[13]

The treatment of an aggressive giant cell lesion of the mandible by combined curettage and cryosurgery was presented with a 5 year follow up without recurrence (Webband Brockband 1986).[19]

Healing following devitalization of sites within the periodontal ligament by ultra low temperatures were investigated by Talt and Stahl (1986). They showed that cryosurgery devitalizes cell in predetermined area in the PDL without causing significant morphologic changes in the periodontion. However, since healing following freezing injury may not be identical to that observed after standard surgery, the histologic sequences described in this study must be considered preliminary. On the other hand, freezing injury may be of value to further study PDL repair potential since this insult does not alter the gross morphology at injured site.[37]

A 22-year study of paroxysmal trigeminal neuralgia in 211 patients with a 3-year appraisal of the role of cryotherapy was performed by Nally (from 1959 to 1981), also, Namzakrzewska managed the 83 patients of PTN by cryotherapy (1987). It was concluded that cryotherapy can give unique results hitherto unachievable by other means of pain control in PTN (17 and 30).

Healing following conventional and cryosurgical discoplasty was performed by Marciani, Harold, Gerald and Roth.(1987) They showed that under the conditions of this experiment the cryosurgical technique was

judged not to be superior to the conventional surgical approach.[10]

Cryosurgical depigmentation of the gingiva was investigated by Kozlvovsky (1987) The treated gingiva appeared normal and remained depigmented until the present time (20 month following freezing). It is concluded that cryosurgery may prove to be the treatment of choice when gingival depigmentation is indicated.[18]

Observation on the effects of two ceramics on the strength of bone subjected to cryosurgery were investigated by Maccord and Bradley (1989) They observed that implants of dense hydroxyapatic an tricalcium phosphate were implanted over rat mandibular bone subjected to cryosurgery increased bone strength which reduced strength following cryosurgery.[5]

Cryosurgical Equipment and Apparatus :

The available apparatus may be classified into open and closed systems involve the direct application to superficial lesions of usually either carbon dioxide snow (79 C) or liquid nitrogen (- 196 C) applied on cotton pledgets or as an open spray. The drop in temperature is profound as the lalent heat of vapourization is extracted from the tissues. Open systems are more applicable to thickened proliferative and invasive lesions where control of the depth of destruction is of secondary importance, and in the treatment of conditions of bone.

Closed systems offer a greater degree of control, but instrumentation is more complex, the depth of freezing being in general less profound than with open systems. The three main types of closed system are (Thomas, 1972);[22,23,30,45,46,4]

1- Thermo-electric . Operating by the peltier effect, the apparatus uses a D.C. current and water cooling. It is less efficient and more cumber some than other closed systems.

2- Evaporative. This depends on the controlled evaporation of usually liquid nitrogen or liquid Freon. This technique can produce a profound drop in temperature (- 190 C), having the same order of activity as open systems.[4,22,23]

3- Joule-Thomson. Here, the escape of a pressurized gas (usually

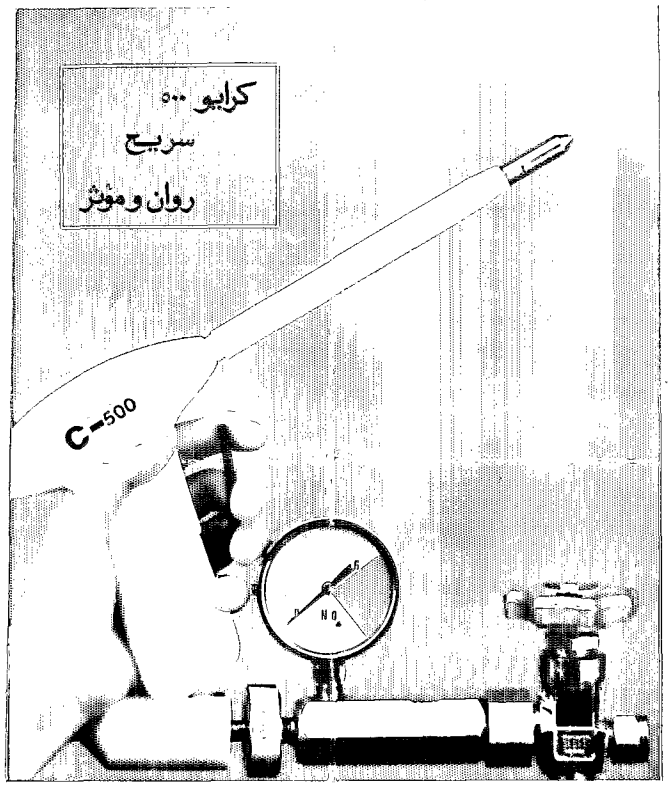

Fig. 2. Cryosurgery device (C-500)