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Dental Evaluation of Cosmonauts

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The dental evaluation of cosmonauts were done under three headings; stomatoscopy, electro-odontodiagnostics and thermal test and lastly complete stomatological investigations. Thirteen candidates were evaluated. All the personnel had some dental disorder requiring dental treatment. However, only one candidate was disqualified for dental condition.

Introduction

Any manned space flight envisages the cosmonaut's absence from his normal habitat for a length of time. In addition to problems like the new medium of movement, that of no atmospheric environment, weightlessness, radiation in its primary form encountered in a space flight etc, he has to remain in a cramped space without outside help or medical aid, without normal food and facility for maintaining proper oral hygiene. Thus, great physical demands are placed on an individual who is selected for a space mission. All efforts, are, therefore, to be made to eliminate conditions which may jeopardize the success of the mission. It is imperative that the dental evaluation be carried out very meticulously. In addition to the oral cavity being disease free, the individual should also be motivated to keep it thus.

However, to oversee any complication in the oral cavity during the flight, the cosmonauts are provided and trained to handle an emergency dental kit. The emergency dental kit is specially designed to meet packaging criteria during prolonged space flights under gravity free conditions.

If the teeth are not cleaned regularly the consequences, will be dental caries or decay, soft, spongy and bleeding gums.

These two dental diseases start quite painlessly and without any discomfort to the individual. It is only when they reach an advanced stage and symptoms like sensitivity to hot and cold stimuli, pain on mastication, progressive loosening of teeth appear that the individual feels the necessity of consulting the dental surgeon. Most times it is too late to save the tooth. It is therefore, imperative that if pain and removal of teeth are to be avoided, timely dental aid must be sought.

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A USAF report indicates higher incidence of periodontal disturbances amongst fliers. This was attributed to lack of proper oral hygiene, fatigue, inadequate diet, nervous tension, excessive use of alcohol and tobacco.

A study carried out by Wg Cdr Zachariah in 1984, on the "Effect of high altitude on periodontal disease" has corroborated the fact that periodontal disease does have a tendency to be adversely affected by changed atmospheric pressure of high altitude.

The dental evaluation of candidates for cosmonaut training is directed towards the detection of dental defects which are likely to handicap the individual in satisfactory performance or which would require prolonged interruption of training for their correction.

The criteria for dental evaluation for our Aircrew are same. Additionally, orthopantographic studies are done for cosmonauts. Extra oral or intra oral radiographs are taken as and when clinical evaluation demands.

The detailed dental evaluation will be discussed under the following headings.

1. Stomatoscopy
2. Electro-odonto-diagnostics and thermal test
3. Complete stomatological investigation.

1. Stomatoscopy

Clinical examination of the oral cavity includes. :

(a) Examination of teeth

(b) Examination of the Alveolar mucosa, and Gingiva

(c) Examination of the periodontium

(d) Examination of the Temporomandibular Joint.

(a) Examination of individual teeth

(i) Dental Caries : Dental caries involves disintegration and demineralisation of the enamel. Subsequently, there is a breakdown of the remaining structure producing micro cavities due to bacterial attack and finally producing clinical cavities.

(ii) Attrition : Is the wearing away of the tooth substance during mastication of food. It can be physiological, associated with normal wear and tear with advancement of age or pathological—it is the excessive wear of teeth producing broad flat or cupped out occlusal surfaces. Generalised occlusal wear causes hypersensitivity of teeth and decrease in vertical dimension. Localised occlusal wear may generate tipping forces which are injurious to the periodontium.

(iii) Abrasion : It is the loss of tooth substance due to mechanical wear other than mastication of food on the facial surfaces of teeth. Most common causes are use of abrasive dentifrices, faulty brushing and action of clasps etc. It produces extreme sensitivity to thermal changes.

When the defects are well developed restorative measures may be required.

(iv) Tooth mobility. It is elicited in advanced periodontal disease frequently in buccolingual direction, very less frequently in mesio-distal direction. In very advanced stages of periodontal destruction vertical mobility also occurs.

Mobility is generally evaluated as under :

N — Normal Physiological Mobility

Grade I (+) — Slight mobility

Grade II (++) — Moderate mobility

Grade III(+++) — Marked mobility in mesio-distal direction combined with vertical mobility.

(v) Pathologic Migration of teeth. Alteraitons in the position of teeth should be carefully noted, specially to elicit abnormal occlusal forces.

(vi) *Overbite.* The projection of the maxillary teeth over the mandibular teeth in a vertical direction is overbite and is a normal feature of the dentition. However, excessive overbite in the anterior region may cause impingement of the mandibular teeth upon the palatal mucosa and food impaction, followed by gingival inflammation, enlargement and pocket formation.

(vii) *Open bite,* In this relationship, abnormal vertical space exists between the maxillary and mandibular teeth, mostly in the anterior region. Reduced mechanical cleansing may lead to accumulation of food debris, calculus formation and extrusion of teeth.

(viii) *Cross bite,* In this the normal overlapping of the mandibular teeth by the maxillary teeth is reversed and maxillary teeth lie lingual to the mandibular teeth. This condition may be local, unilateral or bilateral. Trauma from occlusion, food impaction, spreading of mandibular teeth and subsequent gingival and periodontal disturbances may be caused by crossbite.

(*b*) *Examination of the Alveolar Mucosa and Gingiva*

(*i*) *Alveolar Mucosa* : Adjoins the attached gingiva and has a loose texture and hence is freely moveable over the attached periosteum. It is thin, smooth and red in colour. The alveolar mucosa is continuous along the reflection with the buccal mucosa.

While examining the aveolar and buccal mucosa any change in colour, cheekbiting, indentitions, leukoplakia etc. are to be noted.

(*ii*) *Gingiva* : Normal healthy gingiva is pink in colour, smooth, firm and glossy in appearance. It also shows stipling above the gum margins.

Clinically, in early stages of gingivitis the interdental papillae show painless reddening. Due to inflammatory infiltration the gingiva loose their fir stippled appearance and become soft, shiny a slightly enlarged; bleeding on tooth brushing, dig tal pressure or exploration with a probe is often a early sign; debris and calculus both supra-gingiv and sub-gingival is usually present.

(*c*) *Examination of the periodontium.* The peri dontium consists of the periodontal membrane, d cementum and the alveolar bone. The periodon membrane surrounds and attaches the cementu or root of the tooth to the alveolar bone.

The periodontal membrane attachment at t highest point and the free gingival margin is not t same and normally a sulcus exists. From a clinic point of view, sulcus depth of more than 2 mm in fully erupted tooth is considered pathological. Su pathological sulcus is called a periodontal pocket.

Periodontal Pockets. Sequellae of gingival disea leads to pocket formation causing bone loss a loosening of teeth.

Pockets may be supra-bony or infrabony.

The periodontal pocket is a soft tissue chan and a radiograph may aid in locating pockets a not however, in detecting and measuring them. C nical examination and probing are more direct. T level of attachment of the base of the pocket affo an indication of the severity of tissue destruc that may have affected the periodontium.

(*d*) *Examination of the Temporomandibul Joint.* In the survey conducted on IAF person by Wg Cdr DS Chopra in 1977 it was observed th clenching and grinding of teeth, lip biting and chee sucking habits are peculiar among fliers. Th manifestations of tension contribute to the deve ment of periodontal and temporomandibular jo disturbances.

2. **Electro Odonto diagnostics and thermal Te**

Often some other means of diagnosis m be used in conjunction with the roentgenogram. O of the most useful tests in this respect is the elec pulp test, combined with the thermal test.

Electric Pulp Testing. Electric pulp tester is us to indicate the vitality or nonvitality of the pulp.

The area to be tested is properly isolated and dried to elicit correct response. Usually two readings are taken and recorded.

In general, less electrical stimulus is required than normal in case of Hyperemia of the pulp, Acute serous pulpitis and early stages of Acute suppurative pulpitis. More current is required in other forms of pulpitis and partial necrosis of pulp. No response is elicited in cases of alveolar abscess, Granuloma or cyst. Or, if there is a response it is on a much higher numerical index on the scale because of moisture present in the root canal.

However the response to stimulus should not be taken as indication of vitality of pulp and should be corroborated with stimulus reaction on control tooth and other clinical tests.

Thermal Test. The thermal test i.e. application of heat or cold is a very useful differential diagnostic aid as an adjunct to electrical pulp test. After properly isolating the area, heat test in the form of hot air, a hot burnisher, or a piece of hot gutta percha is applied to the tooth or cold applied in the form of cold air, ice, cotton saturated with ethyl chloride.

The heat test is useful in diagnosing acute suppurative pulpitis and acute alveolar abscess where a painful response is quickly evoked. In necrosis or gangrene of pulp the response is questionable while there is no response in most cases of chronic alveolar abscess, granuloma or cyst.

While using ice or cotton pledget of ethyl chloride normal vital teeth respond in a certain length of time. Hyperaemic pulp or teeth affected by serous pulpitis react in a much shorter time, often immediately, suddenly and painfully. Teeth affected by chronic pulpitis give a delayed response and non-vital teeth no response.

Thermal tests are subjective and not as accurate as the electric pulp test.

3. Complete Stomatological Examination

Panoramic radiographic view (orthopantograph) of the skull is taken which obviates repeated radiographic exposures and concomitant radiation hazards. It helps to accurately evaluate Dentofacial abnormalities. A simultaneous picture of Mandible, Maxillae, Temporomandibular articulation and Maxillary sinuses is available. Interproximal carious cavities, Apical Pathosis, Periodontal disease etc can be easily detected.

Dental Standards

For a cosmonaut the two functions of teeth i.e. Mastication of food and Phonetics are very important.

An individual selected for cosmonaut training is required to be dentally fit for two reasons.

(a) *During Preparation for Space Flight.* Any Dental disability may cause unwarranted break in training which is lengthy and the cost enormous.

(b) *During Space Flight.* There is lack of facility for upkeep of oral hygiene, therefore it is essential that there is no lurking dental disease which may give rise to pain. One can ill afford to abandon a space mission under such circumstances.

Candidates should have sufficient serviceable, vital permanent teeth in each of the upper and lower arches inclusive of third molars to constitute 14 dental points. These teeth should be functionally opposed by natural teeth or artificial teeth on serviceable bridges or partial dentures.

An extruded or malposed tooth which cannot be brought in functional occlusion should not be considered as a functional tooth. Severe malocclusions are considered disqualifying. Other disqualifying conditions are :

1. Extensive caries and defective restorations including bridges and partial dentures.
2. Diseases of the jaws or associated structures such as cysts, tumours, chronic infections, and severe periodontal conditions.
3. Temporomandibular joint disturbances.
4. Pathological bite.

The following is the breakdown of conditions noted in the thirteen candidates dentally evaluated.

Number suffering from Caries	10
Number suffering from Gingivitis	2
Number suffering from Periodontitis	2
Number suffering from impacted molars and requiring extraction	6
Number requiring bridge/dentures	4
Number of teeth requiring restorations ...	28
Number having Cysts/Granuloma/other abnormalities.	NIL
Number of personnel disqualified for dental conditions.	1

These dental standards are by no means very rigid. The dental fitness expected of a cosmonaut is also aimed in Air Force irrespective of the vocation of the individual.

The foregoing however brings out the fact that all the personnel evaluated needed dental treatment to varying degrees. This clearly indicates certain amount of laxity on the part of all concerned, that in spite of annual dental examinations, such high percentage of personnel required dental treatment. It is apparent that either due to the nature of their duties or lack of interest these personnel do not attend to the treatment advised. It is hoped that with more awareness a high state of dental fitness can be achieved.

An effort has been made to cover all aspects of dental evaluation which may affect the safety, comfort and efficiency of cosmonauts. As we are just entering space age there is need to learn a lot more from the experience gained and follow more rigid dental standards for our fliers and future cosmonauts.

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