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TRIVANDRUM DENTAL JOURNAL

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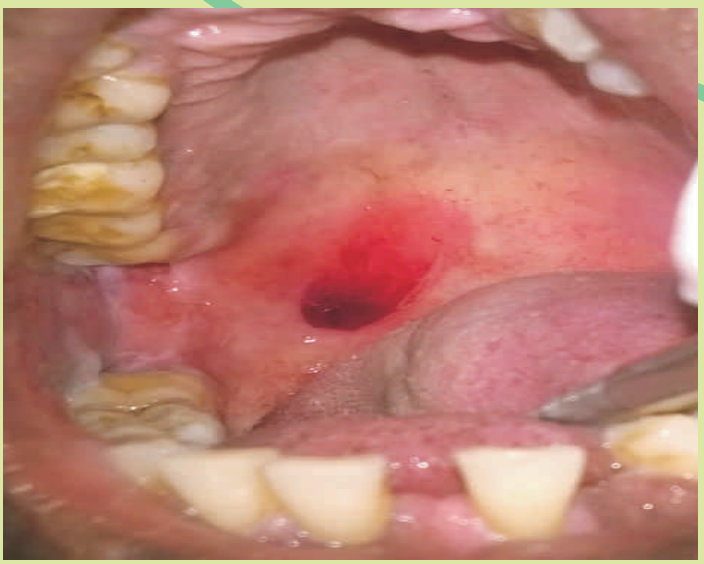

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CONTENTS

ORIGINAL ARTICLE

Role of Ultrasound in the diagnosis of maxillofacial swellings - A Clinical Study

Twinkle S Prasad[1] , Minu Sugathan[2], Anita Balan[3]

Abstract

Background : With the arrival of CT, MRI, Ultrasound and Nuclear medicine in medical imaging, a new era of diagnostic understanding of the maxillofacial region has flowered, though surgical biopsy is the time-honored primary standard for tissue diagnosis. Ultrasonography is a relatively simple, noninvasive imaging modality especially useful for superficial lesions. It is remarkably accurate and easier to perform than CT or MRI. In many cases, it provides a confident diagnosis before FNAC or histology, but in those cases where FNAC or FNAB is indicated, Ultrasound is the imaging technique of choice in guiding the needle to its best target. It is nevertheless, operator dependent. The detail seen is superior to CT or MRI. However it is still underutilized in maxillofacial imaging. **Objectives :** 1. To analyze and study the sonographic features of maxillofacial swellings. 2. To correlate the ultrasound findings in maxillofacial swellings with histopathology and thus assess the accuracy of USS in the diagnosis of such swellings. **Method :** Fifty-six (56) patients with maxillofacial swellings, who attended the Oral medicine & Radiology clinic over a period of one year, were selected for the study. After careful history taking & clinical examination, sonograms were obtained with high resolution real time scanner with an 8-11MHz linear array scanner head. The provisional diagnoses obtained from clinical examination & ultrasound was compared. Histopathological examination was done for the swellings and this diagnosis was taken as the gold standard for comparison. **Results :** Ultrasound was sensitive in diagnosing sialadenitis in 13 cases out of 15 cases. USS of the 9 cases of metastatic lymph node from squamous cell carcinoma showed positivity for 6 cases. Ultrasound scan was 60% sensitive, 100% specific and 92.8% accurate for diagnosing malignancy in maxillofacial swellings. **Conclusion :** Ultrasound scanning is a highly reliable non-invasive technique for rapid investigations of head & neck soft tissue swellings. It may be used as an adjunctive procedure for pre-surgical evaluation of swellings, especially when the relationship with adjacent anatomy poses a surgical dilemma. Ultrasound combined with FNAC is highly accurate due to the low prevalence of non-diagnostic sampling in such settings.

Keywords: Ultrasonography, Dentistry, Maxillofacial swellings.

Introduction

Swellings of the maxillofacial region may be reactive, inflammatory, benign neoplasms, cysts, or malignant tumors. The most common of these are pathologies of salivary glands, odontogenic lesions and lymph nodes. With the arrival of CT, MRI, Ultrasound and Nuclear medicine in medical imaging, a new era of diagnostic understanding of the maxillofacial region has flowered, though surgical biopsy is the time-honored primary standard for tissue diagnosis[1]. Ultrasonography is a relatively simple, noninvasive imaging modality especially useful for superficial lesions. In the soft tissues of the head and neck, most swellings that present to the clinician can be managed with maximal efficiency using ultrasound[2]. It is remarkably accurate and easier to perform than CT or MRI. In many cases, it provides a confident diagnosis before FNAC or histology, but in those cases where FNAC or FNAB is indicated, Ultrasound is the imaging

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technique of choice in guiding the needle to its best target. It is nevertheless, operator dependent. Ultrasound is gaining a lead role in maxillofacial swellings related to salivary glands, neoplasms, thyroid & parathyroid, larynx and site specific swellings, largely due to the increased spatial resolution achieved by the latest generation of machines and transducers. For thyroid nodules, ultrasound provides a more reliable diagnosis than FNAC or scintigraphy[3]. With neck lymph nodes, it is possible to examine their vascularity, not only with color flow and power Doppler, but also with 3D volumetric analysis. The detail seen is superior to CT or MRI.

Aims

The present study analyses the various diagnostic findings of maxillofacial swellings from a variety of causes, by Ultrasound. These findings are correlated with the provisional diagnosis obtained by detailed history and patient examination. The histopathology is done finally, for all cases. Radiological diagnoses obtained by plain film radiography & CT (done in a representative number of cases) is combined with the clinical diagnosis to arrive at a provisional diagnosis. The USS findings are compared with histopathology. The accuracy of USS is assessed by standard statistical methods.

Objectives

1. To correlate the clinical & sonographic findings in maxillofacial swellings with histopathology and thus assess the validity of Ultrasound in the diagnosis of such swellings.
2. To analyze and study the sonographic features of maxillofacial swellings.

Materials and Methods

Fifty-six (56) patients with maxillofacial swellings, who attended the Oral medicine & Radiology clinic over a period of one year, were selected for the study. After careful history taking & clinical examination, ultrasound was done for the swellings. The provisional diagnoses obtained from clinical examination & ultrasound were compared. Histopathological examination was done for the swellings and this diagnosis was taken as the gold standard for comparison. Intrabony lesions and nodes of size less than 4mm were excluded from the study. Also excluded were the patients with severe systemic illness, bleeding diatheses and who were non-cooperative. The cases were collected at random with no preference given to age, sex or any other criteria.

Technique of Ultrasound

Sonograms were obtained with high resolution real time scanner with an 8-11MHz linear array scanner head. The swellings were examined longitudinally and transversely in a continuous sweep technique. Ultrasound findings were documented with special reference to number, location, size, echo pattern & margins of the lesion. Special care was taken to assess the relation of the swelling to adjacent muscles and vessels, especially for lymph node swellings. For very superficial swellings, an acoustic stand off pad was used to improve resolution. The sonograms were interpreted by the same radiologist.

The findings obtained by Ultrasound were compared with the histopathological diagnosis.

Analysis of data was done as follows.

a = true positive
b = false positive
c = false negative
d = true negative
Sensitivity = a / a+c X 100
Specificity = d / b+d X 100
Positive predictive value = a / a+b X 100
Negative predictive value = d / c+d X 100
Efficiency of study = a+d / total cases X 100

A positive Ultrasound-Histopathology correlation is taken as true positive (TP) whereas Ultrasound-Histopathology disagreement is either false positive (FP) ie histology negative & Sonography positive or false negative (FN) ie Histology positive & Sonography negative. Cases where histopathology was negative is taken as true negative. Histopathology is taken to be the gold standard of comparison.

Results

The age of the patients selected ranged from 8 years to 78 years. 55.3 % (n=31) were males while 44.6% (n=25) were females. Out of the 56 swellings, 40 were non-neoplastic in nature. Of the 16 neoplastic swellings, 6 were benign and 10 were malignancies. On histopathological analysis, the majority of swellings were sialadenitis, (27%) followed by reactive change lymph node (21%) and metastatic lymph node. (16%)

Ultrasound was sensitive in diagnosing sialadenitis in 13 cases out of 15 cases. (Figure 1). One case was diagnosed as necrotic node by USS. The histology of this case showed sialadenitis with areas of necrosis and fibrosis in the gland. The USS report may be may be due to an error in interpretation. USS of the 9 cases of metastatic lymph node from squamous cell carcinoma showed positivity for 6 cases. (Figure 2). The 3 cases that had an ultrasound features of non-specific lymphadenitis did not show the classic features of metastasis lymph node like loss of fatty hilum, round shape and peripheral vascularity.

Table 1 shows the charted view of discrepancies between USS and Histopathology. One case of Gorlin cyst was diagnosed as ameloblastoma in USS, the error may be due to lack of penetrance of Ultrasound waves in to bone, which is needed to distinguish between an intrabony cyst and neoplasm. The case of adenoid cystic carcinoma diagnosed as sialadenitis by USS may be an interpretation error.

Table : 1: USS Report and Histopathology

USS REPORT	HISTOPATHOLOGY
Sialectasia	Sialadenitis
Necrosis node	Sialadenitis
Ameloblastoma	Gorlin cyst
Non-specific lymphadenitis (n=3)	Metastatic node (n=3)
Sialadenitis	Adenoid cystic carcinoma

Table 2: Correlation Between USS & Histopathology

HISTOLOGY	FREQUENCY	CORRECT DIAGNOSIS BY USS	INCORRECT DIAGNOSISBY USS
Sialadenitis	15	13 (87%)	2 (13%)
Metastatic node	9	6 (67%)	3 (37%)
Reactive node	12	12 (100%)	0
Abscess/ suppurative lesion	2	2 (100%)	0
Cysts	6	5 (83%)	1 (17%)
Ameloblastoma	1	1 (100%)	0
Pleomorphic adenoma	3	2 (67%)	2 (33%)
Lipoma	1	1 (100%)	0
Angioneurotic odema	2	2 (100%)	0
Hemangioma	1	1 (100%)	0
Adenoid cystic carcinoma	1	0	1(100%)
Thyroid-MNG	1	1 (100%)	0
Thyroid-Colloid	1	1 (100%)	0
TB lymph node	1	0	1 (100%)

Table 3: Validity Of USS

Positive USS	Present in Histology TP = 6	Absent in Histology FP = 0	PPV 100 %
Negative USS	FN = 4	TN = 46	NPV 92%
	Sensitivity 60 %	Specificity 100%	Accuracy 92.8%

True negative cases are those where both histopathology and ultrasound scan show benign lesions. Sensitivity is the positivity of ultrasound scan when malignancy was present. Specificity is the fraction of cases with benign histopathology report that had benign ultrasound scan report.

Table 4: Diagnostic Indices of Ultrasound Scan

Index	Reactive change node	Sialadenitis
Sensitivity	100 %	87 %
Specificity	98 %	98 %
Positive predictive value	92 %	93 %
Negative predictive value	100 %	95 %
Accuracy	100 %	96 %

Discussion

Anil & Rhodri[4] advocates the use of a high resolution, low frequency US machine with a linear 7-11 MHz probe for head & neck swellings. They also advocate the extended-neck position on a mobile table for scanning. Most authors advise the use of 7- 13MHz probe for head & neck USS[5,6,7]. Paul[6] advocates the use of a continuous sweep technique in the head & neck region. In our study, Sonograms were obtained with high resolution real time scanner with an 8-11MHz linear array scanner head. A 45 degree reclined position was used.

Sialadenitis

Ultrasound scan in sialadenitis show a heterogenous pattern due to microabcesses. An illdefined hypoechogenicity is seen in an abcessed gland[4]. Our findings tally with the authors. Ultrasound was sensitive in diagnosing sialadenitis in 13 cases out of 15 cases of sialadenitis, in our study.

Metastatic lymph node

There are many sonographic criteria for detection of metastatic lymph nodes[4]. They include increased size, a more rounded shape, an absent echogenic hilus or a thin hilus with associated eccentric cortical widening, presence of necrosis within the node, presence of a cluster of nodes, spread. Other diagnostic features like sonographic M/Q quotient and contrast enhanced color doppler features have also been described for metastatic node diagnosis[8,9]. Reported figures of accuracy in detecting metastatic cervical lymph node was 75% to 82% in clinically N0 necks[9]. In our study, we found that presence of an echogenic hilus, an oval shape and a central pattern of blood flow to be the most common features for benign swellings. USS of the 9 cases of metastatic lymph node from squamous cell carcinoma showed positivity for 6 cases. The 3 cases that had an ultrasound features of non-specific lymphadenitis did not show the classic features of metastasis lymph node like loss of fatty hilum, round shape and peripheral vascularity.

Reactive lymph nodes

Knappa et al[5] stated that retropharyngeal nodes and micrometastases less than 4mm in size are the limitations of USS in the head & neck. Jorg et al (2000) stated that USS had a sensitivity of 98% and specificity of 100% in diagnosing reactive change in lymph nodes of head & neck. In our study, the sensitivity of USS for reactive lymph node was 100%. The specificity was 98%, with positive and negative predictive values of 92% and 100% respectively. The accuracy of USS was 100% in detecting reactive node.

Conclusion

Ultrasound scan was 60% sensitive, 100% specific and 92.8% accurate for diagnosing malignancy in maxillofacial swellings.. Errors in USS were errors of interpretation. False positive diagnosis was due to error of interpretation while false negative diagnosis was due to error of sampling.

Ultrasound scanning is a highly reliable non-invasive technique for rapid investigations of head & neck soft tissue swellings. It may be used as an adjunctive procedure for pre-surgical evaluation of swellings, especially when the relationship with adjacent anatomy poses a surgical dilemma. The necessity of specific morphologic criteria to distinguish benign from malignant swellings, reduces the specificity of USS when used as a sole method. Ultrasound combined with FNAC is highly accurate due to the low prevalence of non-diagnostic sampling in such settings.

Figure 1:

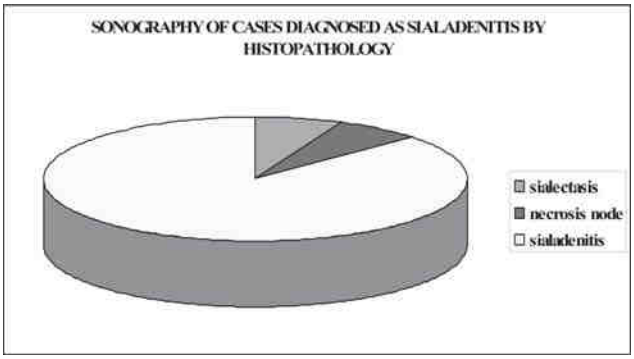
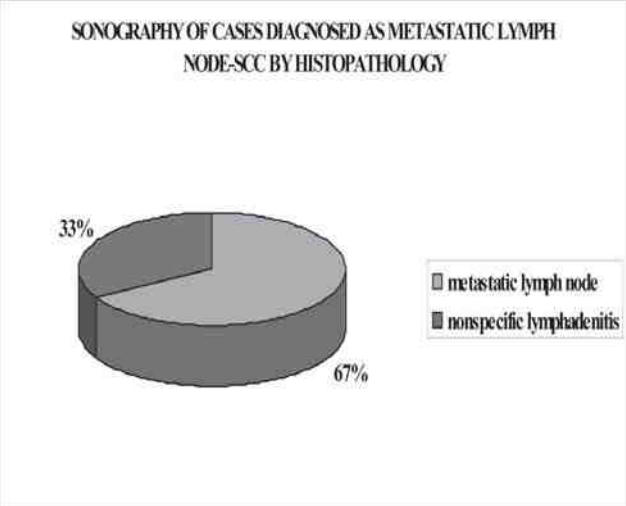


Figure 2 :



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CASE REPORT

White Lesion on Tongue : A Clinico Pathologic Conference

Shabna Fathima S.[1], Jincy Thomas[2], Sunila Thomas[3], Vivek Velayudhan Nair[4]

ABSTRACT

A non-tender, non-scrappable white patch was noted on the left lateral margin of the tongue in a 33-year-old male patient. The differential diagnosis considered were leukoplakia, frictional keratosis, candidiasis, lichen planus, verrucous carcinoma and syphilitic leukoplakia. Incisional biopsy revealed moderate epithelial dysplasia. Leukoplakia is a potentially malignant disorder of oral mucosa. Dentist have an important role in the early diagnosis when leukoplakia is usually asymptomatic.

Keywords: white patch, tongue lesion, leukoplakia

CASE REPORT

A 33 year old male patient reported to the department of Oral Medicine and Radiology for evaluation of a white lesion of the tongue, which was noticed 3 months back. He was a gym coach and gives a positive history of using anabolic steroids for 3 months. Extraoral examination did not reveal any abnormalities. There was no evidence of lymphadenopathy. There was no history of previous similar lesions elsewhere or any systemic complaints. Intraoral examination revealed thickened, painless white plaque measuring approximately 1x2cm on the left lateral margin of the tongue. The lesion had irregular borders. On palpation, the lesion was non-tender and non-indurated. The lesion could not be wiped off.

DIFFERENTIAL DIAGNOSIS

Based on the clinical appearance of the lesion and the patient's significant history of using steroids, leukoplakia was the most favourable clinical diagnosis. Leukoplakia is termed a white lesion of the oral cavity that cannot be scrapped off or designated as any other definable white lesion. Typically, oral leukoplakia ranges from simple keratosis to different severities of epithelial dysplasia to carcinoma in situ. The exact etiology of leukoplakia is unknown, although a widw range of physical and chemical agents, such as alcohol and cigarettes, betel quid, microbial infection and ultraviolet radiation are implicated in the etiopathogenesis of leukoplakia. The clinical appearance of leukoplakia is essentially categorized into 2 forms: homogenous and non-homogenous forms. The homogenous type of leukoplakia is defined as a white lesion exhibiting a thin uniform surface and smooth texture, where as the non-homogenous variety is defined as a white or white and red lesion that exhibits a wide range of surface irregularities, including papillary or veruccous, fissured, wringles, nodular, and speckled. The non-homogenous subtype of leukoplakia, especially that located on the high-risk areas, such as the lateral borders and ventral surfaces of tongue and floor of mouth, carry an increased risk of malignant transformation. Leukoplakias of the tongue, lip vermillion, and floor of the mouth make up more than 90% of the cases of dysplasia and/or carcinoma. Between

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0.13% and 364% of leukoplakia develop into oral squamous cell carcinoma over a follow-up period of 1 to 11 years. This wide variation in the rate of malignant transformation is possibly because of disparity in oral and dietary habits, presence of a lesion in a non-smoker, occurrence in females, erythematous component, thick lesions, presence of pain, presence of dysplasia, and persistence over long periods of time. A biopsy is compulsory for making a definitive diagnosis and deciding the preferred treatment for leukoplakic lesions. The tissue samples should be taken from the clinically most severe area.[1]

Another prime consideration was trauma-induced frictional keratosis. Frictional keratosis of the oral cavity id categorized as a normal hyperplastic response induces because of chronic rubbing or friction. It is most commonly seen in areas that are highly susceptible to trauma, such as the lips the lateral borders of the tongue, buccal mucosa and the edentulous alveolar ridges. It appears as a white lesion with a roughened keratotic surface resembling a callus of the skin. The lesions of frictional keratosis usually completely resolve after the source of trauma is removed. Our patient denied any trauma to the region before the appearance of the lesion. The teeth in the area did not display any sharp or irregular surface and edges. Although the clinical presentation of the lesion favoured frictional keratosis, the possibility of trauma inducing such an intense lesion on the dorsum of the tongue seemed highly unlikely.[1,2]

We also considered candidiasis as one of the differentials, although the clinical characteristics and the patient's medical history did not support this. The lesion did not wipe off.the patient did not present with any predisposing factors for candidiasis, such as acquired immunodeficiency syndrome or diabetes mellitus, usage of broad spectrum antibiotics, or nutrition deficiencies. Therefore, we limited our choice to only the hyperplastic variant of candidiasis. Hyperplastic candidiasis is the least common form of candidiasis and is considered to be a controversial diagnosis. It is speculated to be a candidial infection of an underlying leukoplakia. The most common location for this form of candidiasis is anterior buccal mucosa, at the commissures, followed by the lateral border of the tongue, although it can be found on any mucosal surface. Clinically, the lesion appears as well-defined, occasionally raised with small translucent , white areas of large, dense, opaque plaques. The lesions may also be nodular, homogenous , or speckled. The white plaques of hyperplastic candidiasis are hard and rough to palpation. Most importantly, the lesions do not rub off. Hyperplastic candidiasis exhibiting a speckled clinical appearance usually has an increased frequency of epithelial dysplasia microscopically. These lesions are associated with malignant transformation in up to 15% of reports. A biopsy is mandated when the lesion fails to resolve with antifungal medication.[2]

Another consideration was plaque-type lichen planus (LP), a subtype of reticular LP which exhibits a leukoplakia-like presentation, displaying a smooth or flat surface with irregular or elevated areas. This type is mostly seen on the dorsum of the tongue and the buccal mucosa. It typically manifests as smooth white plaques with atrophy of the papillae. The characteristic white striations are usually not seen in the plaque-type LP. Among the various types of LP the plaque variant was our most favourable choice based on the clinical appearance and the location of the lesion, although the absence of any such lesions elsewhere in the body or in the oral cavity made this diagnosis less likely.[2]

The thickness and the slightly corrugated surface also prompted a likelihood of verrucous carcinoma (VC) as one of the differentials, although the lack of history of smokeless tobacco usage deemed it less favourable. VC is considered to be a well-differentiated variant of squamous cell carcinoma. VC is mainly seen in older men. It may develop in association with long-term use of dry snuff, and corresponds to the site of tobacco

placement. Te most common intraoral sites are the mandibular vestibule, gingiva, buccal mucosa, tongue, and hard palate. The clinical appearance of VC is characterized by thick, well-demarcated plaque with shaggy papillary surface projections. The color of the lesion my vary from white to erythematous to pink depending on the amount of keatinization. VC has the tendency to invade the adjacent structures, including the bone and cartilage if left untreated.[2]

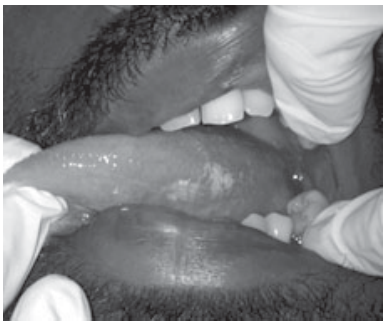
We also considered the diagnosis of syphilitic leukoplakia an oral manifestation of syphilis. It is well known that syphilis may present with a variety of systemic manifestations, supporting its designation as the 'great imitator'. Syphilitic leukoplakia is an extremely rare manifestation of tertiary syphilis presenting as diffuse atrophy of dorsal tongue papillae accompanied by hyperkeratosis. Here is a fourfold increased risk of development of squamous cell carcinoma in these patients, although many authors dispute this. This possibility was not favoured, however because the patient denied history of syphilis.[2]

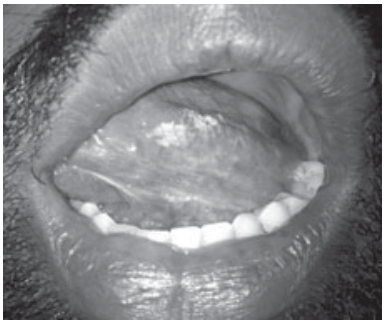
Although white sponge nevus should be considered, the relatively short time course of the lesion and the lack of family history argue against it.

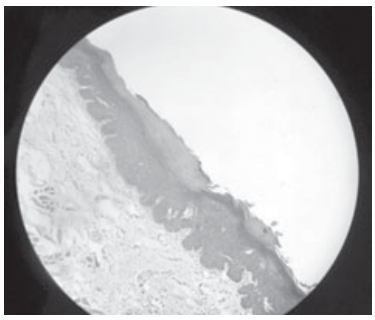
MANAGEMENT AND DIAGNOSIS

An incisional biopsy specimen taken from the dorsum of the tongue. Microscopic examination of the section revealed parakeratinized stratified squamous epithelium with associated moderately collagenous connective tissue. Epithelium shows proliferating and confluent rete ridges in both ends and basilar hyperplasia. Mild chronic inflammatory cell infiltrate is present in the subepithelial connective tissue. A diagnosis of leukoplakia was given.

The patient was prescribed antifungal agent for 2 weeks. On the follow up visit there was reduction in the intensity of the lesion. He was then prescribed topical application of vitamin A and antioxidants. The patient is kept under follow up.







DISCUSSION

Oral leukoplakia (OL) is a potentially malignant disorder of oral mucosa. WHO in 1978 as a white patch or plaque which cannot otherwise be characterized clinically or pathologically as any other disease. In 2012 van der Waal proposed a new definition which includes the histological confirmation "A predominantly white lesion or plaque of questionable behavior having excluded, clinically and histopathologically, any other definable white disease or disorder". [3]

The prevalence rate of oral leukoplakia varied between 1.7 to 2.7% in general population.

OL is often found among men, and its prevalence increases with age advancement. It has been estimated that it mainly affects men over 40 years.[4]

The etiology of OL is considered multifactorial, but smoking is the frequently involved factor. It is much more common among smokers than among non-smokers. Alcohol is thought to be an independent risk factor but definitive data are still lacking. There are conflicting results of studies related to the possible role of human papillomavirus infection. As OL can mimic a large variety of lesions, in case a possible causal factor is suspected such as dental restoration, mechanical irritation. In the later case a subsequent evaluation in 4 weeks is needed.[3]

OL is classified in two main types: homogeneous type which appears as a flat white lesion and non-.homogeneous type which includes speckled, nodular and verrucous leukoplakia. The homogeneous leukoplakia is a uniform, thin white area altering or not with normal mucosa. The speckled type is a white and red lesion, with a predominantly white surface. Verrucous leukoplakia has an elevated, proliferative or corrugated surface. The nodular type has small polypoid outgrowths, rounded predominantly white excrescences.[1]

Proliferative verrrucous leukoplakia is a subtype of verrucous leukoplakia characterized by an aggressive evolution, a multifocal appearance, resistance to treatment, higher degree of recurrence and a high rate of malignant transformation.[5]

Histological appearance of oral leukoplakia varies between no dysplasia and carcinoma. Dysplasia reflects histological changes which are followed by the loss of uniformity or of the architecture of the epithelial cells.

The risk factors for malignancy of OL such as vicious habits (smoking, alcohol intake), clinical form, location of lesions were studied. Among them, tobacco cigarette smoking was reported to be the most important etiological factor for the development of oral premalignant lesions and to their progression into oral carcinoma.[6]

The usual clinical examination of oral mucosa is most frequently visual. It is the standard conventional method for oral cancer screening. It depends on the experience and skills of the clinician. But the risk level of the lesion is difficult to measure. There are many variants of adjunctive techniques for the detection of potentially malignant disorders, including oral leukoplakia.

The main objective in management is to detect and to prevent malignant transformation. At the first, the ceasing of the risk activities such as smoking is recommended. The degree of dysplasia will guide the choice of the treatment. Oral leukoplakia presenting low malignant risk (no dysplasia or simple displasia) may be either completely removed or not, and the decision should consider other factors such as location, size and, in the case of smokers, the patient's engagement in smoking cessation. In the presence of moderate or severe epithelial dysplasia, surgical treatment is recommended. The surgical treatment can use conventional surgery or laser ablation, electrocauterization, or cryosurgery. Recurrence of OL after surgical treatment has been reported in more than 10% of cases.[3]

CONCLUSION

The role of the dentist and general practitioner is important in the early diagnosis when leukoplakia is usually asymptomatic and it is simple to remove possible factors involved in its etiology -smoking, thus reducing the rate of malignant transformation.

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REVIEW

Microarray Technology: Review, Applications And Future Prospects

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Abstract

The gold standard for diagnosis of oral disorders is the histopathological analysis of tissues. This diagnostic method remains the standard by which all other diagnostic tests are measured. However, the practice of pathologists depending solely on histopathological diagnosis is being replaced by more specific molecular and immunological diagnostic methods. The identification of new molecular markers for diseases is a tedious task. Thus, microarray technology, which allows simultaneous analysis of thousands of samples on solid substrates, will play a very important role in future research. In this article we review the various types, techniques, applications and advancements in microarray technique.

Keywords: Molecular markers, Microarray technology

Introduction

The field of pathology is presently undergoing significant changes, in large part due to advances in molecular analysis of tissue samples. The completion of the human genome sequence recently, has allowed the researchers to extend their studies, seeking genetic factors that are involved in complex multifactorial disorders. These advances have permitted researchers to have insights into many developmental, infectious, inflammatory, metabolic and neoplastic disorders. Moreover, molecular analysis also led to improvements in the accuracy of disease diagnosis and classification [1].

Oxford Dictionary has defined microarray as a set of DNA segments of known sequence representing the complete set of genes of an organism, arranged in a grid pattern for use in genetic testing. It is a technique that allows simultaneous analysis of thousands of samples on solid substrates [2]. Thus microarray technology helps us in getting faster results in tedious experimental procedures. The general uses of microarray technology includes: (i) Genetic mapping and discovering gene expression profiles in various disorders, (ii) Gene regulation studies, (iii) Diagnosis by identification of patterns of gene expression that define disease states and that may represent prognostic indicators and (iv) Drug discovery and toxicology [3].

In this review we broadly describe the various types, techniques, applications and advancements in microarray technique.

Types of Microarrays

A. Nucleic acid microarrays

Nucleic acid microarrays, or genome chips, use the principle of specific nucleic acid base pairing. They are generated by immobilizing specific nucleotide probes on a supporting matrix, which subsequently binds to their complementary targets [4]. Glass microscope slide, nylon, silicon and nitrocellulose membranes are the supporting matrices usually used [7]. The nucleic acid probes usually used are cDNA, DNA and oligonucleotides [4].

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The principle of DNA microarray technology is based on the fact that complementary sequences of DNA can be used to hybridise immobilised DNA molecules. This involves five major multi-stage steps:

i) *Manufacturing of microarrays*: This step involves the availability of a chip or a glass slide with its special surface chemistry, the robotics used for producing microarrays by spotting the DNA (targets) onto the chip or for their *in situ* synthesis.

ii) Sample preparation: This step involves mRNA or DNA isolation followed by fluorescent labelling of cDNA probes and hybridisation of the sample to the immobilised target DNA. Initially, total RNA is isolated, which contains mRNA that ideally represents a quantitative copy of genes expressed at the time of sample collection. The quality of the RNA sample isolated is important as the outcome of any microarray experiment depends on it. Then, using a reverse-transcriptase enzyme, sample mRNA extracted from the sample and the reference sample are converted into their corresponding complementary DNA (cDNA). Next, each cDNA are labelled with a different labelling molecule, mostly a fluorescent cyanine dye.

iii) Array hybridization: This step involves hybridisation of the sample to the immobilised target DNA. Hybridisation is the process of joining two complementary strands of DNA to form a double-stranded molecule. Here, the labelled cDNA (Sample and Reference) are mixed together, and then purified using filter spin columns to remove contaminants such as primers, carbohydrates, lipids, cellular proteins and unincorporated nucleotides. The mixed labelled cDNA is then competitively hybridised against denatured PCR product or cDNA molecules immobilized on a glass slide. Molecules in the labelled cDNA should bind specifically to its complementary target sequence on the array.

iv) Washing: Any labelled cDNA that did not hybridise on the array, is then removed by washing. Cross hybridization is prevented by either increasing the temperature or lowering the ionic strength of the buffers [12].

v) Image acquisition and data analysis: Finally, this step involves microarray scanning, and the image analysis using sophisticated software programs that allow us to quantify and interpret the data. The slide is first dried and placed into a laser scanner to determine how much labelled cDNA is bound to each target spot. Laser excitation of the labels causes a spectral emission. This characteristic spectrum is analyzed using a confocal laser microscope. Usually green spots ore used to represent the genes that are unregulated, compared to the control sample, yellow to represent the genes of equal abundance in both experimental and control samples and red to represent the genes that are down-regulated in the experimental sample[7].

Applications of Nucleic Acid Microarray Technology

Depending on the samples arrayed and markers used, the microarray technology has a very wide range of applications. Since the elaborate details of each one is beyond the scope of this review, the main applications can be summarized into two distinctive applications:

i) Gene expression profiling to measure the expression of genes between different cell populations.

ii) Comparative genomics to analyse genomic alterations such as sequence and single nucleotide polymorphisms [3,5,8].

B. Tissue Microarrays

The basic idea of multi tissue blocks, was first described in 1986 by Battifora as a 'sausage' method for immunohistochemical control and standardization between laboratories. The tissue microarray (TMA) technique was described in its current shape by Kononen et al. as late as 1998. Since 1998, TMA has become well established as a method for 'high-throughput' of tissue samples for immunohistochemistry (IHC) and in situ techniques [9].

The TMA technology is an economical, time-efficient and statistically powerful method that will greatly facilitate translational research. With the microarray technique, up to 1000 minute tissue samples are arrayed and analyzed simultaneously. As these datasets are typically present in the form of formalin fixed paraffin-embedded tissue blocks, immunohistochemical (IHC) methods are ideal for validation. However, performing whole-section IHC on hundreds of blocks requires a large bulk reagents and a lot of time. In addition, an average block will yield less than 300 slides of 5ìm each. The tissue microarray (TMA) technique solves some of these problems [10].

The main advantage of TMA technology is that several hundred representative cores from several hundred patients can be included on a single glass slide for assay. Thus, significantly more tissue can be conserved than if the blocks were to be sectioned serially.

The major disadvantage of TMA's is that each core (or set of cores) represents a fraction of the lesion. However, multiple studies in different organ systems have now demonstrated that consistent and comparable results can be obtained using TMA cores as with whole sections [12].

Applications of Tissue Microarray Technology

The most obvious advantage of TMA's lies in the large number of cases that can be processed cheaply and quickly. A typical TMA block with 240 (80 cases with three cores from each case) 0.6mm cores takes 6-8 hours to construct, added to the time for cutting and staining a single section. In contrast, it has been estimated that an experienced laboratory technician will require 24 hours to cut and stain 80 cases for IHC [9].

Although the TMA technique was initially described for characterization of biomarkers in cancer research as the conventional methods were far too elaborate, the utilization of this technique is promptly expanding. Simultaneous assessment of molecular markers of clinical relevance in hundreds of tissue specimens has significantly made many advances in cancer research. Theoretically, anything that one can do with regular tissue section could be extrapolated using TMA. The high-throughput approach for analysis of intact tissues allows validation of relative frequencies of molecular targets by IHC, FISH, mRNA, and ISH [10].

TMA blocks can be stored for future studies. If a new marker looks promising, a single section from a TMA could test it on a large panel of tumours. A whole project could be carried. TMA's are extremely well suited for large-scale IHC studies. Staining variability decreases because all cases in a TMA block are processed on a single glass slide [9].

To maximize the success study of various studies, proper consideration must be given to the array source. Some researchers construct their own slides, which require a high level of technical expertise and resources. TMA's are most commonly used for cancer studies and for basic research. A major concern in using TMA for cancer research is tumour heterogenecity. If only a small part of the tissue is analyzed, some alterations may go undetected. However this is of minor significance if the research is aimed at studying expression profiles of tumour populations rather than individual cases [9]. As molecular research intended at identifying specific diagnostic markers are increasing and focus of rational drug design and development come to the fore, TMA's may evolve into a standard investigational tool [10].

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REVIEW

Tongue print: an undeniable proof in biometric authentication – A brief review

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Abstract

Biometrics based authentication is emerging as the most reliable solution for establishing the identity of individuals in a variety of applications. Although many conventional systems are available for biometric identification each one has its own drawbacks. Tongue print collected from the dorsum of the tongue carries a great deal of information along with its visual difference in shape, texture and pattern. In this paper, we are discussing on the various aspects of tongue prints and its recognition as a biometric tool.

Key words: Tongue print, biometric, authentication, digital.

Introduction

Biometric system recognizes persons based on their physiological (e.g., finger print, iris) and / or behavioural (e.g., signature) characteristics or traits. This technology finds various applications for human authentication in areas including secure control access and forensics. The dorsum of the tongue carries a great deal of information along with its visual differences in shape, texture and pattern, which is referred to as the 'tongue print'. Current modes of biometric systems include finger print, palm print, iris scan, face recognition, voice recognition and signature verification. Tongue prints have been found to be unique for each individual and thereby can be a remarkable tool for biometric authentication.[1]

Categorization of tongue prints

Classification of tongue features based on categorization of tongue parameters was put forth by Stefanescu et al in 2014. According to him tongue texture consists of physiological, scrotal and geographic with tongue shape as ovoid, ellipsoid, rectangular, pentagonal, trapezoid to asymmetrical. The longitudinal groove include perceptible/ imperceptible, rectilinear/twisty, superficial/deep with sharp/septate lingual apex.[2,3] Tongue prints can also be classified based on five visual parameters such as pattern, margin, shape, fissure, and texture.[4] (Refer Table 1).

Table-1: Steps for digital conversion of tongue print

Categorization Of Tongue Parameters [PMSFT]	
Pattern	Reticular, Wavy, Linear , Horizontal
Margin	Smooth, Scalloped
Shape	U- Shape, V- Shape, Square
Fissure	Type- 1 (Continous central fissure) Type- 2 (Noncontinous central fissure) Type- 3 (Continous central fissure with lateral fissures) Type- 4 (Noncontinous central fissure with lateral fissures) Type- 5 (Lateral fissures only) Type- 6 (Absence of fissures)
Texture	Velvety, Pebbly, Matted

Digital conversion of tongue print images

Computerised tongue image classification comprises of two important steps which are tongue image acquisition and tongue diagnostic software. The software part consists of both image processing part and database system for archiving and managing acquired tongue images. The digital conversion of tongue print images requires the following steps:

1. Image acquisition

A good quality photographic image is the prerequisite for the computation procedure. The individuals are asked to protrude the tongue outwards and downwards keeping it in the most relaxed position without extra effort. Images of

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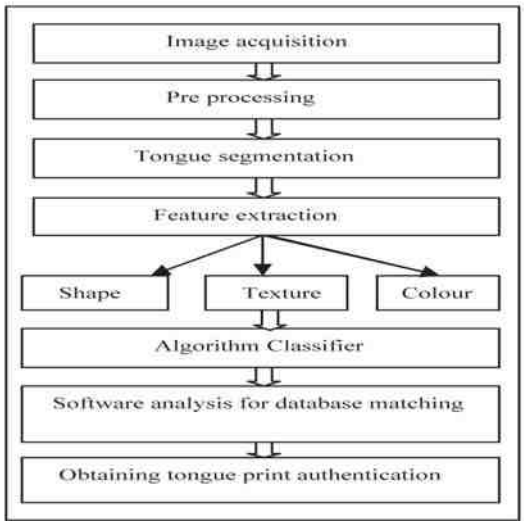
Steps for digital conversion of tongue print images



dorsal tongue are captured under the standardized lighting conditions using a Hi-tech digital SLR camera with fixed head position and tongue protrusion while maintaining the distance of subject to camera.[4] The environment are also taken into consideration and flash is provided if the lighting of the place is not enough for the colour accuracy of the tongue image.

2. Pre-processing

The original tongue images are subjected to image pre-processing before performing feature extraction. Tongue localisation and normalisation are the two important software procedures in pre-processing. This is done by image stretching and extraction of region of interest from original tongue images. ROI's (Region of interest) tongue blocks are selected on the central part of original tongue images manually. The size of whole ROI is preferred to have 128 x 128 pixels and the sub-block having 64 x 64 pixels. The image processing part has tongue boundary detection and tongue colour/shape/texture recognition algorithm.[5]

3. Tongue segmentation

Tongue segmentation is one of the most essential steps in automated tongue diagnosis. It is the method of cropping used to detect the boundary of tongue body. Previous works on tongue segmentation used regular gradient operator to detect the boundary of tongue body and then active contour model is utilized to crop the tongue area. More recently automated tongue segmentation has been done by combining polar edge detector, edge filtering, edge binarization and active contour model. The active contour model (dynamic contour model) is a mechanical visual approach to select the edge of an item. Active contour is a technique used for extracting salient features from an image.[6]

4. Feature extraction

Shape parameter is calculated by using control points which gives the prominent outlines of shape feature of tongue. Polar edge detection is used to extract tongue boundary and tongue edge detection algorithm for tongue area separation. Edge line interpolation is recommended for user interface system for archiving and managing acquired tongue images.[7]

Colour information is of great importance for the tongue inspection by computer-aided tongue diagnosis system. In the tongue image, the colours of the tongue body are classified as light pink, rose pink, red and purple. RGB colour histogram is used to analyze the different colours of tongue.[7] However, the RGB signals generated by different imaging devices varies greatly due to the usage of different kinds of digital cameras and dissimilar lighting conditions.

Tongue print textures for personal authentication have been done using Wavelet approach and in this approach statistical measures are applied to the processed images to extract features. Texture of tongue features have also been extracted on basis of Steerable filters and Weber Law Descriptor. Steerable filters have been used to extract region of interest from the original tongue images, where as Weber Law Descriptor are used for local feature extraction.[5, 8]

5. Algorithm Classifier

The statistics which used to describe the processed images for pattern recognition are fed to the k-NN classifier (k-nearest neighbour algorithm). It is a nonparametric method which assigns query data to the class that majority of its k-NN belong to and the performance of k-NN depends on the number of the nearest neighbour k. The statistics used to describe the processed image are the mean, standard deviation, smoothness, third moment, uniformity and entropy. The objective of k-NN classifier is to find the value of k that maximizes

the classification accuracy and these classifiers have the ability to explain the classification results.[8]

6. Soft ware analysis for database matching

Matching feature points between images is one of the fundamental issues in computer vision tasks. The tongue images that form training and testing databases are randomly selected. Finally, the correction recognition is computed for each experiment. The Matlab software is used to perform wavelet analysis (extract texture features from tongue images) and to train and test the k-NN classifier. So the classifier have been trained and tested with k varying from one to five so that the best recognition rates can be obtained.[8] To make tongue recognition more secure there is a need for tongue biometric template with three views left and right lateral view and profile view. This is done since tongue is a non-rigid organ and due to the difficulty for a person to keep it straight. Matching the tongue prints are applied by using algorithms and is done by calculating Euclidian distance that is between edge ridge end and all other ridge ends. It is also similarly done between all bifurcations to achieve high accuracy after taking the average for both input images.[9]

Conclusion

An ideal biometric system depends on parameters such as system reliability, cost effectiveness, flexibility, and necessity of physical contact with the scanning device. Tongue recognition is predicted to support the facet of identification and non- repudiation of information. The human tongue presents both geometric outline and physiologic texture information which are potentially useful in identity verification applications.[10, 11]

A biometric system is essentially a pattern recognition system which recognizes a user by determining the authenticity of a specific anatomical characteristic possessed by the user. The complexity of the tongue prints due to the combination of multiple recognizable parameters makes it an ideal tool for biometric authentication.

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REVIEW

Revisualising Esthetics - A Glance Into 4D Printing : A Literature Review

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ABSTRACT

Statement of problem. Success of an esthetically and functionally efficient extra coronal restoration depends upon the precision in the tooth preparation as well as the manufacturing procedures. The competent and successful practitioner must therefore have a strong background in basic tooth preparation procedures, be knowledgeable of laboratory procedures and keep abreast of the emerging digital technologies.

Purpose. The purpose of this article is to review latest advances in the field of fixed prosthodontics with the introduction of 4D printing.This information would enable clinicians to improve quality,accuracy and longevity of prosthesis.

Keywords: multi material, multi-layered,esthetics,automated manufacturing,4D printing

Introduction

With the introduction of digital technologies beginning with shade selection systems, intra oral scanners and CAD/ CAM SOFTWARE, skillful human manufacturing effort was considerably diminished by concising the entire tedious process of shade selection, impression making, die preparation,wax pattern fabrication and investing. This was followed by 3D printing technologies which further simplified process and now the technology have come up till 4D printing.

Major challenges encountered during fabrication of an extra coronal restoration is difficulty in inculcating natural appearance and biomechanics concurrently. Multi –layered restorations are aesthetically pleasing compared to monolithic restorations. This review describes the prospect of automated manufacturing of multi material multi-layered anterior esthetic restorations with help of digital technology called 4D printing.[1]

Digitalizing Era

1971 marked the initial attempts for computer-assisted production of dental restorations. Commercialization of portable computers fastened development in the area of computer-aided design/ computer aided manufacturing (CAD/CAM) systems. [2] History of 3D printing can be traced back in 1984 when the technology for printing physical 3D objects was developed by Charles Hull. He named it stereolithography and obtained a patent in 1986.

All 3-D printers use 3-D CAD software that employs an additive manufacturing of series of cross-sectional slices on a layer-by-layer basis.The 3-D machine uses a computer-controlled ultraviolet laser to harden thin layer of liquid resin in the specified cross-section pattern and excess is washed off using chemical bath.[9]

Two main benefits of 3-D printing over other rapid prototyping technologies is cost effectiveness and its ability to seamlessly integrate with computer-assisted design (CAD) software and other digital files like magnetic resonance imaging.[9]

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Manufacturers including Zcorp, Objet Geometries, Dimension, Designcraft, Stratasys and 3D Systems introduced 3 D printers in market.Raw materials such as plastics,resins,super alloys such as nickel-based chromium and cobalt chromium ,stainless steel.,Titanium,polymers and ceramics are being used.[9]

Material & Methods

1. Capture and Digitize[1]

❖ *Analogue numerical capturing*
❖ *Computed tomography/cone beam computer tomography*
❖ *Micro computed tomography*
❖ *Ultrasonic acquisition*
❖ *Light-optical acquisition*

2. Print [1]

❖ *Binder jetting :* Stereolithography (SLA), Selective laser sintering (SLS),Indirect 3D-printing (powder bed printers),LOM-Technologies (laminated object manufacturing).

❖ *Material jetting :* Fused deposition modeling-technologies (FDM),Direct 3D-printing, 3D-material-extrusion of pastes, Polyjet-technologies.

Workflow[1]

1. Additive Build Up Of Sliced Data
2. Slicing Of Data
3. Analysing STL Data
4. Surface Quality Optimisation
5. Generation OfSTL Data
6. Data Aquisition

Only monolithic restorations were manufactured until 2014 since the combination of 3D-multipart and multicolour printing in a single manufacturing process was not possible using the technology.

A thorough understanding of the histo-anatomic structures and dynamic light interaction of the natural dentition such as the tri-dimensional form of the dentine core, defined by the dentino-enamel junction,the sigmoid curve distribution (convex enamel/concave dentine) and outer enamel surface enabled the invention of 3D multilayered multimaterial printing with help of 4 D printing.

Junctinal interface of enamel and dentin is due to the difference of birefringence between the tissues.The DEJ is less mineralized than either enamel or bulk dentin, conversely being richer than either in organic matrix. The microstructure of enamel is dominated by hydroxyapatite crystal-rich enamel rods, cemented together by an organic matrix protein,where as microstructure of coronal dentin appears to be that of a mineralized collagen fiber bio-composite, the intertubular dentin being the matrix and the dentin tubule lumens with their associated cuffs of peritubular dentin forming the cylindrical fiber reinforcement.polymer.[5]

4D Printing

Fabrication of an extracoronal restoration is a highly technique-sensitive procedure that needs a considerable amount of experience, several steps are often necessary to achieve pleasing aesthetic outcomes. Thus **Automated Digital Fabrication of Multi-layered restorations** is gaining more acceptance.

Printing dental restorations by additive manu-facturing with different materials of different properties and colours is now possible in one build-up process called **MULTI-MATERIAL-3D-PRINTING/4D PRINTING**.[1]

Various multi-material 3 D-printers currently in market are PolyJet-3D-printing (Stratasys), MultiJet-Printing (MJP; 3D Systems) and MultiJet Fusion–3D-printing (Hewlett Packard).WZR-Multimaterial - 3D - printing (WZR ceramic solutions GmbH, Rheinbach) is the only system indirect multi-material-printer available and is patented by WZR.[1]

3d Multi-material-printing of replicas of Natural Teeth

Replicas of extracted intact natural teeth were produced and subsequently evaluated.For the aquisition of datasets, extracted teeth were scanned using micro-computed tomog-raphy (exaCT S Desktop-CT S60 HRE; Wenzel Volumetrik GmbH, Singen, D) with a voxel-size of 45 ìm. The aquisition software 'exaCT Control Analysis' (Wenzel Volumetrik GmbH, Singen, D) was used to generate STL-data of the enamel (including OES

and DEJ), as well as data of the dentine core including the root and pulp cavity.[1]

The optimisation of the surface quality used the software Sensable Freeform (3D Systems, Rock Hill, US). Dependent on the individual situation the 'natural blueprint' might be manually altered using existing CAD-software.STL-data were analysed with the software Magics RP (Materialise, Leuven, Belgium), to detect and eliminate possible errors within the dataset. The positioning of the teeth on the printing platform and the slicing of datasets was obtained with the software Objet Studio (Stratasys, Eden Prairie, MN).[1]

On the basis of the sliced datasets the teeth were additively build up using the direct-3D-printing-system 'Objet260 Dental Selection' (Stratasys). The Objet260 Dental Selection is the most current 3D dental printer with triple-jetting-technology.[1]

Applied Materials

For the root and dentine-core the material 'Objet VeroGlaze MED620' was used in shade A2. This material exhibits sufficient strength and form stability and a translucency compa-rable to natural dentine. VeroGlaze is currently approved for temporary intraoral application of maximum 24 hours. Therefore it can be applied for diagnostic try-ins and mock-ups.[1]

The incisal area was printed using the trans-parent and strong material 'Objet MED610 Biocompatible, Clear'.Both materials were printed simultaneously. For the outer surface,glossy-mode was enabled to create automatic surface finish..The object to be printed has to be positioned in the right direction on the platform because the remaining surfaces facing the platform (where the support structure touch platform) stay with a mat finish.[1]

Evaluation Of Printing Results

Evaluation criteria for printed object included the 'aesthetic appearance' and the 'surface quality'. The additively produced teeth show light dynamic effects and esthetic appearance that simulate natural model teeth. They are likely caused by the scattering of the light on the dentine-core, leading to several specific effects in the incisal area.[1]

Conclusion

There are many advantages for 4 D printing like predictable esthetical results and optical behavior, fast production and reproduciblility, economical and considerably simplified manufacturing effort. Current drawback of additive materials is that the photopolymers have only been approved for intraoral use for only 24 hours. The material has only been tested for irritation.Medical accreditation regarding cytotoxity, genotoxity, type 4 hypersensitivity has to be obtained yet.Inferior mechanical properties is another major disadvantage.[1]

With advancement in newer technologies,these disadvantanges are expected to be overcome in recent future.

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REVIEW

A Quest For Gold Standard In Implants

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ABSTRACT

With technological advancement, treatments with dental implants have gained increased acceptance by patients. Competitive researches are in progress all over the world to reach the goal of ideal implant material that simulates a natural tooth. Here is a review of leading implant materials that are vying to claim the title of ideal implant material

Key words :dental implants; implant materials; titanium; zirconia; PEEK; tantalum;Roxolid;titanium–zirconium; biocompatible; titanium gold alloys.

Introduction

The favourable long-term clinical survival rates reported for titanium and its biomedical alloys have made titanium the "gold standard" material for the fabrication of endosseous dental implants. The principal disadvantage of titanium is its dark greyish colour, which often is visible through the peri-implant mucosa, therefore impairing esthetic outcomes in the presence of a thin mucosal biotype. Unfavourable soft tissue conditions or recession of the gingival may lead to compromised esthetics. This is of great concern when the maxillary incisors are involved. Furthermore, it has been suggested by various investigators that metals are able to induce a nonspecific immunomodulation and autoimmunity. Galvanic side effects during contact with saliva and fluoride are also represented. Although allergic reactions to titanium are very rare, cellular hypersensitivity reactions have been demonstrated. To overcome these limitations and minimize negative biological reactions, researches have been focused on designing alternative substitutes to titanium[6]. The novel materials include Zirconia, PEEK, Ti-Ta alloy, Ti-Zr alloy and Ti-Au alloy (a promising material which can be introduced into implant dentistry)

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Ideal Properties[7]

1.Modulus ofElasticity Comparableto Bone
2.Increased Interfacial Shear Strength
3.High Compressive Strength and Tensile Strength
4.High Yield Strength and Fatigue Strength
5.Minimum Of 8% Ductility
6.Increased Surface Tension and Surface Energy
7.Increased Surface Roughness
10.Corrosion Resistance
11.Biocompatibilty
12.Flexural Strength
13.Decreased Bacterial Adhesion
14.Osseointegration

Zirconia[1]

High Strength Zirconia ceramics have become attractive as newmaterials for dental implants. Yttriastabilized tetragonal zirconiapolycrystals (Y-TZP) with or without the addition of a small percentage of aluminaare used for producing dental implants.

Advantages : 1) Esthetic - The fact that ceramic materials are white and mimic natural teeth better than the grey titanium allows an 'improved esthetic reconstruction for patients. Using white ceramic implants would preclude the dark shimmer of titanium when the soft peri implant mucosa is of thin biotype or recedes over time.

2) Highest uni axial flexural strength among ceramics

3) Highest fracture toughness among ceramics- Osman et al mentioned that at room temperature and upon heating up to 1170 °C, the structure is monoclinic. It assumes a tetragonal shape between 1170 and 2370°C and a cubic structure at a temperature higher than 2370 °C and up to the melting point. Alloying pure zirconia with stabilizing oxides, such as CaO, MgO, Y2O3 or CeO2, permits the retention of the metastable tetragonal structure at room temperature.Dental procedures, like grinding or sandblasting, can trigger a tetragonal to monoclinic transformation within the surface region . This transformation is accompanied by a considerable increase in volume (~4.5%) that induces surface compressive stresses, thereby closing the crack tip and enhancing resistance to further propagation. This characteristic, known as transformation toughening, will increase the fracture strength and fracture toughness of Y-TZP ceramics compared with other dental ceramics.

4) Osseointegration comparable to Ti (BIC >60%)Deprich et aldemonstrated that zirconia implants with modified surfaces resulted in an osseointegration that was comparable with that of titanium implants.

5) Significant reduction in bacterial adhesion

6) Periimplant tissue compatibility- The inflammatory response and bone resorption induced by ceramic particles are less than those induced by titanium particles, suggesting the biocompatibility.

Disadvantages: 1) Low temperature degradation- As previously mentioned, a certain degree of surface tetragonal-monoclinic transformation can actually improve the mechanical properties of Y-TZP. However, a small range exists between improvement and destruction of mechanical properties. The transformation of one grain results in a volume increase, thereby stressing the neighbouring grains and generating microcracking, which enables further water penetration, crack propagation and phase destabilization.

2) High Young's modulus - It has been proven that a big difference between the elasticity of the implant material and bone leads to greater stress generation due to differential deformation under load. This stiffness mismatch can lead to bone resorption as a result of stress shielding.

PEEK[3]

Advantages: 1) Elastic modulus and density close to bone(CFR-PEEK) The reinforcing agents used may be carbon fibers, beta-tricalcium phosphate, hydroxyapatite or titanium dioxide contained within a PEEK matrix. The filler content makes the implant isoelastic, i.e. density and elasticity (Young's modulus) identical to bone. Although pure polyaromatic polymers exhibit elastic modulus that varies from 3 to 4 GPa, this value can be changed to attain a modulus close to cortical bone (18 GPa) with the addition of fibers.On the other hand, the Young's modulus of titanium and its alloys vary from 110 to 150 GPa.

2) BIC greater than Ti

3) Esthetic-Their white colour makes them ideal for use in the esthetic zone

4) Better imaging (MRI &CT)friendly- the presence of metallic implants i.e. titanium and its alloys significantly and negativelyimpacts the quality of the resultingimages. On the other hand, the implantsmade of reinforced PEEK polymer areradiolucent and this feature allowsavoiding scatter in further CTs or MRIs.

5) Do not generate heat during modification- As a result, the coronal portion of the single piece implant can be immediately modified (like crown preparation for FPD) to meet the prosthetic requirement.

Disadvantages: 1) No inherent Osseo conduction 2) CFR PEEK (Carbon fiber reinforced PEEK) not esthetic 3) Lesser strength

Ti-Ta ALLOY (TRABECULAR METAL)[5]

It is not until the early 1990s that porous tantalum trabecular metal (PTTM) was introduced.PTTM, known commercially as Trabecular Metal Material (Zimmer, Trabecular Metal Technology, Inc.,

Parsippany, NJ) is an open-cell porous biomaterial with a structure similar to trabecular bone by having three-dimensional dodecahedron repeats.

Advantages: 1) Excellent corrosion resistance and biocompatibility

2) Osteoconductivity, Bone Ingrowth and Vascularization - PTTM structure allows neovascularization and new bone formation directly into the implant. This concept is known as "Osseo incorporation"

3) PTTM exhibits an elastic modulus similar to bone and is mechanically superior to other alloys used in dental implants

4) Improved tensile strength than Ti.

Disadvantages: 1) While tantalum itself is similar to titanium in that it is highly biocompatible and corrosion resistant, the interactions with oral fluid, oral microbes and biofilm of the PTTM portion are not known.

2) Increased bacterial adherence

3) Fracture of implants - Due to implant manufacturing, the connection between the relatively small titanium core/PTTM in the middle-third portion and the apical titanium portion may be prone to fracture especially if they are placed in hard bone (type 1) with in appropriate high torque. These implants are however recommended for bone that are relatively soft (type 3 or 4).

Ti-Zr ALLOY[4]

Advantages: 1) Biocompatible -a new Titanium–Zirconium alloy (Ti–Zr) has been developed (Roxolid; Institut StraumannmAG, Basel, Switzerland). This material is made of titanium alloyed with 13–15% of zirconium. This metal alloy is highly biocompatible and allows the same surface treatment, sand blasting and acid etching, as commercially pure titanium grade IV.

2) High strength

3) Corrosion resistance

4) Application in small diameter implants - to restore a reduced mesiodistal space, reduced crestalwidth (narrow ridge), and reduced amountof interradicular space

5) Tensile strength of Ti increased with additionof Zr

6) Increased Elongation and fatigue strength than pure Ti

7) Excellent osseointegration

8) Reduce the need for bone regeneration - less residual bone is needed for implant insertion.

Ti Au ALLOY[2]

Swanidze et al explained that Ti_3Au has significantly enhanced hardness while preserving its biocompatibility. The only other intermetallic compound with a similar hardness value is Ti_3Ir, the biocompatible properties of which remain unknown**.**

Among the Ti–Au binary compounds, Ti_3Au is the only cubic one, which is consistent with high mechanical stability and, therefore, high hardness.

Advantages: 1) Increased density, 2) Biocompatibility, 3) Improved corrosion resistance, 4) High mechanical stability

Disadvantages: 1) Increased hardness.

Conclusion :

Comparing newer materials based on their desirable properties for an implant, TiZr alloy and Zr are found to have more ideal properties compared to its competitors (basedon available information). But we are yet to find the perfect material which will cater to all the biological and mechanical requirements of an ideal implant. And for certain, this area has immense scope for further research and development.

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ABOUT THE JOURNAL

The Trivandrum Dental Journal, the official publication of the Indian Dental Association , Trivandrum Branch, is intended to be a research periodical that aims to inform its readers of ideas, opinions, developments and key issues in dentistry - clinical, practical and scientific - stimulating interest, debate and discussion and an opportunity for life long learning ,amongst dentists of all disciplines. All papers published in the TDJ are subject to rigorous peer review by our excellent review board. We have tried to design the journal in such a way that the readers can find the relevant information fast and easily.

The journal is intended for dentists, dental undergraduates, members of the dental team, hospital, community, academic and general practitioners.

To start with, we have

Review articles: scientific peer-reviewed papers with a focus on clinical research to enable researchers and scientists to communicate their findings to the rest of the community.

Case reports: articles, and papers on the latest developments and information relevant for those in dental practice.

This section contains essentially case reports and general articles about clinical matters.

Practice section:. to include clinical guide, how-to-do-it papers, dental business articles ,and the latest developments and information relevant for those in dental practice.

Abstracts: a selection of abstracts from dental journals.

We plan to include

Opinion section: intended to keep the readers aware of what people are thinking in dentistry today, and introduce differing views for debate by including letters and articles expressing the views and opinions of people that are open to debate and discussion.

Education section: any type of paper, article or report that is relevant to the vital subject of dental education, whether it is undergraduate, postgraduate, specialist or lifelong learning Summaries: this section acts as a bridge between the practice and research sections, providing a summary of the research papers in this issue. Besides the abstract and 'in brief ' box, in this page, we plan to includes a comment on each paper by a specialist in the field, emphasizing the relevance of the paper , to ensure that the information from the research is easily available to both practitioners and researchers.

The cover page design

The shanku or the conch was considered as one of the common emblems of majority of Kerala feudal kingdoms of the past, including Travancore. The official Kerala state emblem also symbolises two elephants guarding the imperial conch and its imperial crest. The graphical representation of the conch (' shanku') is adapted to be the design on the cover page of the TRIVANDRUM DENTAL JOURNAL.

The Cover Photograph : Blood Filled Bulla in a patient with Pemphigus.

Differential diagnosis : Angina bullosa hemorrhagica (ABH) Bullous Lichen planus, BMMP, Epidermolysis Bullosa, Linear IgA disease. Cicatrical pemphigoid, Fixed drug reaction.

Photo courtesy : Dr. Capt. Vivek V.

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