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Prof. Dr. V. Shankar Ram, M.D.S., Ph.D.,
President
IDA Madras Branch

PRESIDENT'S MESSAGE

Dear Members,

Greetings from IDA Madras Branch!

IDA the premier organization of dental professionals secures the dignity and honour of its members, besides enhancing the image of the profession. Out of more than 450 local branches IDA Madras branch bear more members than any other branch.

Research is an integral part of science and dental science is not an exception. I hereby invite you all to send us well researched articles for publications along with case reports, reviews and professional experience to enrich our scientific knowledge.

My warm regards and good luck is always with dynamic editorial team pioneered by Dr. C.K. Dilip Kumar our editor. May the team continue their saga of continuous publication for the years to come.

A handwritten signature in blue ink, written in a cursive style, belonging to Prof. Dr. V. Shankar Ram, M.D.S., Ph.D. The signature is positioned above the printed name and is being written by a hand holding a pen.

Prof. Dr. V. Shankar Ram, M.D.S., Ph.D.,



Dr. H. Thamizhchelvan
Hon. Branch Secretary
IDA - Madras Branch
Hon. Secretary National CDH
IDA (Head Office)

SECRETARY'S MESSAGE

Dear Friends,

Nice to see you all after a long time. As you all know IDA Madras has done guiness attempt towards oral hygiene and received "Asia Book of Record holder" and "India Book of Records" for conducting mass number of tooth brushing(23,615) school children at SRMC and conducting All India Student Conference(Midas 2017) at SRMC, which witnessed 3000 students all over from the nation.

Very Happy to inform that to our branch have received four awards.

1. Dr. U.S. Krishna Nayak Award for Best Local Branch President
- Dr. A.P. Maheswar
2. Dr. Keki Mistry Award for Best scientific activity.
3. Dr. Ramakanth venson Award for Best student activity.
4. Dr. J.M Rao Award for Best student activity.



Dr. H. Thamizhchelvan



Dr. C.K. Dilip Kumar
Editor-in-Chief
IDA - Madras Branch

LETTER FROM THE EDITOR

"With the new day comes new strength and new thoughts"

-Eleanor Roosevelt

The sun goes high in the sky just to prove its presence. We welcome all the readers with super hot wishes through our first issue of this year. This issue is oriented in illuminating us with new energy and new thoughts. I hope all our readers could use these elucidative articles to gear up their brains.

A handwritten signature in blue ink, written in a cursive style, appearing to read 'Dr. C.K. Dilip Kumar'. The signature is positioned above the printed name and is partially overlaid by a hand holding a pen.

Dr. C.K. Dilip Kumar

EDITORIAL BOARD

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MIDAS -2017 ABSTRACTS OF BEST E-POSTER AND BEST PAPER

PAPER PRESENTATIONS (Continued...)

INTENTIONAL REIMPLANTATION OF ENDODONTICALLY TREATED TOOTH

T. Rajalakshmi

Intern
Chettinad Dental College
and Research Institute
Chennai

**MIDAS Reg. No.: IDA
1126**

**Subject: ENDODONTICS
& CONSERVATIVE
DENTISTRY**

ABSTRACT:

Non-surgical retreatment and non-surgical endodontics are not always viable solutions to endodontic disease. Situations like

- Avulsed tooth presented to the clinician in appropriate time
 - Traumatized tooth
 - Tooth with anatomical limitations like -bone thickness, nerve and sinus proximity.
 - When accesses for surgical treatment is limited
- are the conditions that can be best treated by intentional replantation. The paper presentation will enlist the absolute indication and contraindications, procedure, prognosis and success rate of intentional re-implantation.

WHERE IS ORAL AND MAXILLOFACIAL SURGERY???? A QUESTIONNAIRE STUDY

R. Vishali

CRRI
Adhiparasakthi Dental
College and Hospital
Melmaruvathur

**MIDAS Reg. No.: IDA
2288**

**Subject: ORAL &
MAXILLOFACIAL
SURGERY**

ABSTRACT:

Scope of oral and maxillofacial surgery occurred in Egypt in the so called Edwin smith papyrus (2700bc). Oral and maxillofacial surgery is a specialty of dentistry, but the typical oral surgeon functions more like a hybrid between Medicine and Dentistry. The work performed by the OMFS doesn't start and end with teeth, it expands to incorporate procedure that are lifesaving, as well as those that enhance the quality of life by priority better function and aesthetics. The OMFS is a rapidly growing speciality in the priority better functions such as treatment for Trauma, Dentofacial deformities, TMJ disorders and many more completely new methods have been developed such as distraction osteogenesis, hybrid implants, tissues engineering, reconstructive surgeries, treatment for sleep apnea and facial cosmetic surgeries. In this study awareness of OMFS among the medical professionals promoters while being guardians and ambassadors for the this speciality.

VIRTUAL REALITY FOR DENTAL ANXIETY, A TRAIL REVIEW

Krithika. S

3rd Year BDS

Priyadarshini Dental
College and Hospital
Chennai

MIDAS Reg. No.: IDA
1286

Subject: PEDODONTICS
& PREVENTIVE
DENTISTRY

ABSTRACT:

One of the most challenging aspects of dental care today is the management of patient pain. Analgesics have been the main stream solution for alleviating pain in the act. However, research in the recent times have emphasised the use interface of distraction to treat pain. Virtual reality is one such distraction technique that refers to a human computer generated environment. The patient acn navigate through beaches, forests, themeparks and other pleasant areas. Hence, the patients attention will be more or less "drained" from the real world, leaving less attention available to the real world process including painful stimuli. This paper discusses the role of virtual reality in anxiety and pain management in child and adult patients.

MASTER THE POSTURE (ERGONOMICS IN ORTHODONTICS)

M. Bharath

3rd Year BDS

Adhiprasakthi Dental
College and Hospital
Melmaruvathur

MIDAS Reg. No.: IDA
2134

Subject:
ORTHODONTICS

ABSTRACT:

Ergonomics is an applied science concerned with procedure for maximum efficiency and safety. It deals with how to formulate the work more efficient and in simplified manner. Scientist may develop musculoskel problems with proper sitting posture and movements. Orthodontics speciality needs a range of finest movements in co- ordination with vision and unsupported arm work. This increase the duration of work, in stress and strain to the muscle creating musculoskel problem. MSD referred to condition involve nerve, tendon, muscle and supporting structures of the body Ergonomics deals with the etiology in the generation of soreness and pain in dentists and correcting them by proper ergonomics and also corrective measures for proper position and handling the dental materials in orthodontic practice. Ergonomics along with regular exercise, relaxation techniques help us to combat stress increasing comfort, improving the quality of life and to extent careers.

AN INSIGHT INTO THE FORSENIC CONGNIZANCE AMONG THE ADVOCATES

VarshaBaska

3rd Year BDS
SRM Dental College and
Hospital
Ramapuram, Chennai

MIDAS Reg. No.: IDA
1298

Subject:
PHARMACOLOGY

ABSTRACT:

Humans gave us crimies; law gave us justice; science gave us forensics.

AIM: The aim of this study is to assess the knowledge, awareness and perception on forensic dentistry among the Lawyers in Tamilnadu.

MATERIALS AND METHODS: A pretested questionnaire consisting of 10 questions were circulated among the lawyers of the districts salem, Chennai and Trichy which were chosen by simple random sampling. The data was collected on their years of experience. Based on their years of experience and place of practise their awareness was assessed using Chi square test and the p-value was set at 0.05

NEED FOR THE STUDY: Like the minute details of our fingers and the deoxy ribonucleic acids that codes our life are unique to each person, the denetion and its associated structuresare also idiosyncratic. Forsensic dentistry is a sector involves the relationship between both law and dentistry forensic odontology is a benediction and has helped in deciphering many ambiguous cases. Systematic collection of dental records and preservation of the same would marshal the legal officials in identification of the deceased. This presentation is an analytical study in forensic discipline of law which was done to find the cognizance among advocates and the employment of forensic odontology in medicolegal cases. A questionnaire was designed in such a way to assess the awareness of forensic dentistry among advocates and also their participation in any case which involved its use. From the results of 200 advocates who were categorized based on years of experience and place, a conclusion was arrived relating to the awareness and cases handled.

RESULTS: The study is in progress and the results are yet to be formulated.

NANO TECH - THE LIFE JACKET OF IMPLANTS!

Deeptha Mathi

Intern
Sri Venkateswara Dental
College and Hospital
Chennai

MIDAS Reg. No.: IDA
2441

Subject:
IMPLANTOLOGY

ABSTRACT:

Peri - implantitis is a destructive inflammatory affecting the soft and hard tissues surrounding the dental implants. Peri - implantitis is caused by various factors like development of biofilm on the surface of implants, trauma from occlusion, smoking etc.. Treatment modalities like scaling. SRP with plastic currettes. Flap surgery with generative Procedures and photodynamic therapy have been used to treat peri - implantitis.

Nanotechnology has been an emerging field in dentistry. Recent advances has brought in a combination of silver, titanium oxide and hydroxyapatite nanocoating application to the surface of implants. Surface coatings with nanoparticles help in the formation of an anti - surrounding bone and accelerated bone healing.



Evaluation of Salivary Ferning for Predicting Ovulation using Smartphone Mounted Microscope

Dr. Malar A.D.A, Dr. K. Raghavendhar Karthik

¹ PG Student

² Reader

Dept. of Oral Pathology
SRM Dental College,
Ramapuram. Chennai

Introduction

Providing low cost alternative solutions for medical diagnosis is one of the key constituents of making universal health care practical, affordable and accessible to one and all. In line with this principle, there has been a plethora of innovations with the advent of mobile technology and data networks, making the concept of tele-pathology a reality. The connectivity and portability are very ideal for providing point of care diagnosis or Tele diagnosis or even assist in self detection in remote and resource limited areas. The advanced camera features present in the Smartphone can be used in capturing good resolution images, storing and sharing for further validation

Mobile phone-based microscopy has been designed for diagnosis of malaria in peripheral blood smear. A paper microscope called foldscope uses smart phone to capture the image of blood smear and magnifies the image¹. Recently, University of Division of Medical Laboratory Technology, Ghana demonstrated that mobile phone-mounted Foldscope and reversed-lens Cell-Scope are more sensitive and specific than conventional light microscopy in diagnosing *Schistosoma haematobium*-parasitic infection².

A cost effective optical cell-phone based transmission polarised light microscopy was found effective for imaging the malaria pigment known as hemozoin³. These cost effective technological applications have not yet penetrated to all levels of health care provision.

Our study aims to evaluate efficiency of mobile mounted microscope in visualising salivary ferning (crystallisation or arborisation) pattern that is strongly associated with pre-ovulatory increased estrogen levels, in predicting the fertile days for conception. Since the Leutinising hormone (LH) surge is a consequence of increased estrogen levels, the LH surge is evaluated using commercial LH urine strip in fertile female subjects as a marker for ovulation. Self-detection of ovulation using commercial strip that detect luteinizing hormone in urine sample are commonly used by women to aid in conceiving or avoiding pregnancy. Other natural method that aid in detecting ovulation time includes basal body

temperature and cervical mucus characteristics, but they may be misdiagnosed⁴. A simple, easy to use device that uses a hand-held microscope to visualise ferning pattern in saliva has been recently introduced commercially⁵. In this study it is proposed that, evaluating salivary ferning using mobile mounted microscope is far economical than using LH strips for urine analysis for self-evaluation and the images captured can be stored and shared for further validation.

Ovulation is the process of release of secondary oocyte. This occurs on an average, on the 14th day from the last menstrual period (LMP). During last two days of menstrual cycle, the fall in estrogen, progesterone and increase in gonadotropin releasing hormone secondary to it cause rise in level of follicle stimulating hormone (FSH). FSH recruits ovarian follicles that are destined to ovulate in next menstrual cycle. FSH activates the formation of estrogen. When estrogen reaches >200pg/ml for approximately 50hrs duration, surge of luteinising hormone occurs, causing release of ovarian cell. LH surge is a relatively precise predictor for timing ovulation as the peak of LH surge precedes the ovulation by 12 to 24 hours⁶.

Several researchers have studied ferning pattern in body fluids such as cervical mucus and saliva⁶. Crystallization (with NaCl) of cervical mucus and saliva are characterised by the content of the mucoprotein⁷. During the pre-ovulatory period when estrogen dominates, the mucous secretions are thin and watery called which facilitates migration of spermatozoa through mucus. In mid-luteal stage when the progesterone hormone dominates the mucus is thick and sticky with reduced water content⁸.

Thus, increasing levels of estrogen and adreno-cortico tropic hormone before ovulation stimulates the secretion of aldosterone, which regulates the electrolytes and fluid status in human body⁹. Increased level of estrogen alters vaginal and salivary secretion and forms "fern like pattern" due to crystallisation of sodium chloride on mucus fibre⁸.

Materials and Method Study Samples

20 female subjects aged between 23 to 39 years having regular 28 or 30-day menstrual cycle volunteered and participated in this study. The exclusion criteria were non- usage of any hormonal contraceptives, estrogen antagonists, intrauterine devices, pregnancy and breast feeding.

Written consent was obtained from all the subjects. The study was conducted between June 2016 to June 2017 in the SRM Dental College, Ramapuram, Chennai.

Material used

A mini microscope (Universal mobile microscope) which can be clipped on to android Smartphone to view or capture magnified image through phone camera. The microscope has a 200x magnification power and a LED illuminating system attached to it. Ferning pattern of saliva was visualised with it.

Ovulation test strips (Egens biotechnology) that detects luteinising hormone in urine sample was used.

All the subjects were given prior instructions regarding collecting salivary samples and using the ovulation test strips and the test was done at home.

Detection and evaluation of salivary ferning

Samples were collected everyday of fertile window (10th day LMP to 17th day LMP) and on 23rd and 24th day of LMP (to check for absence of salivary ferning). All subjects were instructed to avoid taking food for two hours prior to taking salivary samples. A thick drop of saliva was directly placed on clean glass slide and allowed to dry. The slide with dried salivary

sample was studied by the investigator for presence and quality of ferning pattern and the image was captured using the mini microscope and Smartphone camera. The ferning pattern was given a scoring of 0 or 1 (0 if no ferning pattern was detected, 1 when a ferning pattern was seen irrespective of the nature of crystallisation).

Detection of LH surge in urine

The ovulation strip was used every day of fertile window (10th PMD to 17th PMD) and on 23rd and 24th day of PMD (to check for post ovulatory consequential reduction of estrogen levels). As per manufacturer's instruction the subjects performed ovulation test by immersing the strip below the indexed line on the strip and then placed on a flat surface. Any change in colour of the test line and control line are noted. The result is recorded as positive if test and control line changed to pink colour and as negative when there is no change of colour in test line.

Results

The data regarding salivary ferning test and LH surge test as studied throughout the fertile phase (10th to 17th PMD) as well as post ovulatory days (23rd and 24th days) are given in the Table 1.

The data was further selected and tabulated (Table 2) to include the details of salivary ferning test in the immediate vicinity of LH surge. In the table 2, the LH surge day is considered as the 0th day. And the immediate preceding three days to LH surge are designated as -1, - 2, -3 days. Following evidence of LH surge, the immediate three days is designated as +1, +2, +3 days.

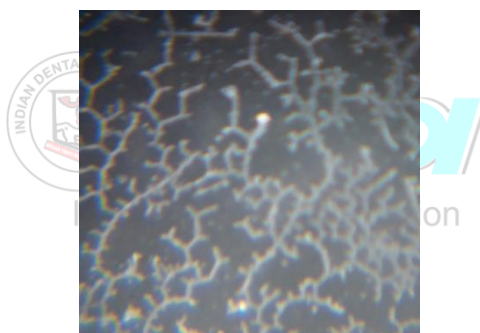
Sample no	10 th LMP		11 th LMP		12 th LMP		13 th LMP		14 th LMP		15 th LMP		16 th LMP		17 th LMP		23 rd LMP		24 th LMP	
	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine	Saliva arborization	LH-urine
1	0	0	0	0	0	0	1	0	1	1	1	0	1	0	1	0	0	0	0	0
2	0	0	0	0	0	0	1	0	1	1	1	0	1	0	1	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0
4	0	0	0	0	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0
6	1	0	1	0	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0
7	0	0	1	0	1	0	1	0	1	0	1	1	1	1	1	0	0	0	0	0
8	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0
9	1	0	1	0	1	0	1	0	1	1	1	0	1	0	1	0	0	0	0	0
10	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	0	1	0	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0
12	1	0	1	0	1	0	1	0	1	1	1	0	1	0	1	0	1	0	1	0
13	0	0	1	0	1	0	1	0	1	1	1	0	0	0	0	0	1	0	1	0
14	1	0	1	0	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0
15	1	0	1	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0
16	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	1	0	1	1	1	0	1	0	1	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0
19	0	0	0	0	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0

Table 1: Details of salivary ferning and LH surge test results during the fertile phase (10th to 17th PMD) and in the post ovulatory days (23rd and 24th PMD)

samples	-3	-2	-1	LH+Ve D	1+	2+	3+
1	0	0	1	1	1	1	1
2	0	0	1	1	1	1	1
3	0	0	1	1	1	0	0
4	0	0	1	1	1	1	1
5	0	0	0	0	1	1	1
6	1	1	1	1	1	1	1
7	1	1	1	1	1	1	0
8	0	0	0	1	1	1	0
9	1	1	1	1	1	1	0
10	0	1	1	1	0	0	0
11	1	1	1	1	1	0	0
12	1	1	1	1	1	1	1
13	1	1	1	1	1	0	0
14	1	1	1	1	1	1	1
15	1	1	1	1	1	1	1
16	1	1	1	1	0	0	0
17	0	0	1	1	1	1	0
18	0	0	1	1	1	0	0
19	0	0	0	0	1	1	1
20	0	0	0	1	1	1	0

Table 2: Presence or absence of salivary ferning in the immediate pre-ovulatory and post ovulatory phase in relation to LH surge day

SCORE - 0 (no ferning pattern detected)	SCORE - 1 (small ferning pattern detected)	SCORE - 1 Wellformed arborization
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Statistical Analysis

	Estrogen peak				
Salivary Arborization	Present	n	Absent	n	Total
	Positive	True Positive a=66	False Positive c=4		a + c = 70
Negative	False Negative	b=14	True Negative	d=36	b + d = 50
	Total	a + b = 80		c + d = 40	

Table 3: Cross tabulation of details of salivary ferning test correlating to estrogen peak results on the day preceding LH surge (-1 day), the day of LH surge positivity (0th day), and the two days following LH surge (+1 and +2 days)

A total of 80 observations were analysed in the selected 4 days (n= 20, and observations repeated for

four consecutive days). Fisher's Exact Test as done to check for level of significance between salivary ferning and its causal factor, estrogen peak that is known to occur one day prior to LH surge. The two-sided p value was found to be <0.001 and was statistically highly significant. Following that accuracy tests including sensitivity, specificity, positive predictive value and negative predictive value were calculated and given in the Table 4.

STATISTIC	VALUE	95%CI
Sensitivity	82.50%	72.38% to 90.09%
Specificity	90.00%	76.34% to 97.21%
Positive Predictive Value	94.29% (*)	86.62% to 97.68%
Negative Predictive Value	72.00% (*)	61.24% to 80.71%
Accuracy	85.00% (*)	77.33% to 90.86%

Table 4: Statistical evaluation of accuracy tests for salivary ferning in relation to estrogen peak based on LH surge day positive result

Discussion

Ultrasonography is standard reference for ovulation detection since it can be used to observe the maximum growth of dominant follicle (>15mm on ultra sound). It is used extensively as an investigative tool in assisted reproductive techniques⁹. Detection of the luteinizing hormone (LH) surge in serum or in urine is also accurate for determining ovulation and hence for predicting favourable time for conception.

The interval of potential fertility was defined as the fertile window beginning 8 days prior to and ending two days after the identified ovulation day¹⁰.

Since the objective of the study was to narrow down the most fertile day(s) within the 10th to 17th day, it was essential to study the salivary ferning pattern in the immediate vicinity of LH surge day. Also, as the estrogen peak happens just prior to (approximately 24 hours) LH surge day, it is important to study the crystallisation that happens in saliva in the preceding days to the LH surge. It is known that the LH surge lasts for approximately 12 to 24 hours immediately after which ovulation occurs. Hence the analysis was focussed on the -1 day, 0th day of LH surge and +1 and +2 days after LH surge day. The +1 days after LH surge is considered as the day of ovulation. The additional day (+2 day) after LH surge was also considered due to the impracticality of determining the exact time when oocyte will be released, in the absence of ultrasound test.

The results of this study showed that among the 80 observations of test for salivary ferning and presumed estrogen peak days (derived from LH surge positive test result), the true positive observations are 66 meaning salivary ferning exactly predicts and coincides with the estrogen peak. While the 14 false negative observations indicate that despite estrogen peak the salivary ferning is absent and does not appear to coincide and be predictive. Thus, giving a sensitivity of 82.5% (72.38% to 90.09% of 95% CI).

On analysing the post ovulatory phase (23rd and 24th PMD) when estrogen levels are considerably reduced, there is no evidence of salivary ferning in 36 out of 40 observations (true negative). Thus, giving a specificity of 90%. (76.34% to 97.21% of 95% CI.) These results are similar to several previous studies.

In 1992, a study involving 300 women found a definite correlation between oestrogen activity and crystallization of saliva, claiming that accuracy of detecting ovulation is 98%, hence will be helpful for women as an additional aid in detecting the fertile period¹¹.

Two studies conducted to evaluate commercially available ovulatory monitoring system (Knowhen and Geratherm) in saliva, found salivary ferning to have good predictive value. In the study to evaluate Knowhen monitoring system, the salivary ferning pattern had 96.5% sensitivity⁵. Salmassi et al evaluated the Geratherm ovu control kit which showed specificity of 78% and sensitivity of 89.4%¹².

Contentious results were found by studies on salivary ferning predictability. Berardona in 1993 showed that salivary ferning was not reliable as their study showed that salivary ferning can be formed during any time in menstrual cycle and more so can occur in pre-pubertal, post-menopausal, pregnant woman and even in male subjects¹³. Maruzio Guida et al evaluated the efficacy of different ovulation detection methods used in natural family planning in comparison with pelvic ultrasonography and concluded that measuring urinary LH levels is an excellent method for determining ovulation, while the salivary ferning test is not an accurate method for detecting ovulation. The results revealed the urinary LH correlated 100% with ultrasound evidence of ovulation, while the sonographic detection of ovulation with salivary ferning was only 36.8%. Interestingly 57.8% of salivary specimens were reported as being "uninterpretable" by the subjects. The authors suggested that the large percentage of interpretable results could have been due to the fact that many of the patients were not taught to use the microscopes or interpret the slides properly. This point is important because adequate patient instruction is the key to the successful use of this method of ovulatory surveillance¹⁴. In current study analysis of slide was done by the investigator allowing accurate interpretation of result.

Gunther stated that salivary ferning can be affected by numerous factors like fluid intake, dehydration, drugs and systemic disease that modify salivary secretions and solute concentration¹⁵.

The results of the current study show cyclical changes in saliva as well as in urinary LH concentration. Previous studies have shown that the time sequences of hormonal changes in estrogen and LH are responsible for salivary ferning and LH urine test positivity respectively. The mean interval from the estrogen peak to ovulation was 34 hours and the interval from the estrogen peak to the LH peak was 24 hours⁶.

The results of current study show saliva can be used to narrow down the fertile day(s) in the menstrual cycle. Women can use the salivary ferning test as a indicator for ovulation when planning a pregnancy to help maximize their chances of conceiving. The difference caused by the time sequences of hormonal changes

could be an advantage of the saliva test that it allows to identify the fertile period that much earlier.

References

1. James S. Cybulski, James Clements, Manu Prakash. Foldscope: Origami-Based Paper Microscope. PLOS ONE 1. June 2014. Volume 9. Issue 6.
2. Ephraim R. K. D., Duah E., Cybulski J. S., Manu Prakash, D'Ambrosio M.V., Fletcher D. A., Keiser J., Andrews J. R., and Bogoch I. I. Diagnosis of Schistosoma haematobium Infection with a Mobile Phone-Mounted Foldscope and a Reversed-Lens CellScope in Ghana. *Am. J. Trop. Med. Hyg.*,92(6), 2015, pp. 1253-1256
3. Prirnstil C. W. and Cote G. L. Malaria Diagnosis Using a Mobile Phone Polarised Microscope. *Sci Rep.*5, 13368; doi: 10.1038/srep 13368 (2015)
4. Hsiu-Wei Su, Yu-Chiao Yi, Ting-Yen Wei, Ting-Chang Chang, Chao-Min Cheng. Detection of ovulation, a review of currently available methods. *Bioengineering & Translational Medicine.* 2017;1-9
5. Melnick and Goudas, The Detection of a Salivary Ferning Pattern Using the Knowhen Ovulation Monitoring System as an Indication of Ovulation. *J Women's Health Care* 2014, 4:3.
6. Reed BG, Carr BR. The Normal Menstrual Cycle and the Control of Ovulation. [Updated 2015 May 22]. In: De Groot LJ, Chrousos G, Dungan K, et al., editors. *Endotext* [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000.
7. Melnick and Goudas, The Detection of a Salivary Ferning Pattern Using the Knowhen Ovulation Monitoring System as an Indication of Ovulation. *J Women's Health Care* 2014, 4:3.
8. Cortés ME, González F, Vigil P. Crystallization of Bovine Cervical Mucus at Oestrus: An Update. *Rev Med Vet.* 2014; (28): 103-16.
9. Fabiana Y. Nakano, Irogério De Barros F. Leão. Sandro C. Esteves. Insights into The Role of Cervical Mucus and Vaginal Ph In Unexplained Infertility. *Medical Express (São Paulo, online)* vol.2 no.2 São Paulo Mar./Apr. 2015.
10. Hsiu-Wei Su, Yu-Chiao Yi, Ting-Yen Wei, Ting-Chang Chang, Chao-Min Cheng. Detection of ovulation, a review of currently available methods. *Bioengineering & Translational Medicine.* 2017;1-9.
11. Arévalo M, Sinai I, Jennings VA fixed formula to define the fertile window of the menstrual cycle as the basis of a simple method of natural family planning. *Contraception* 2000; 60: 357-360.
12. Galati G., Trapani E., Yacoub M., Toccaceli M. R., Galati G. M., Fiorelli C., Bandiera F., Paolillo A. A new test for human female ovulation diagnosis Vol: 6 - No 1, 1994.
13. A. Salmassi A.G. Schmutzler F. Püngel M. Schubert I. Alkatout L. Mettler. Ovulation Detection in Saliva, Is It Possible? *Gynecol Obstet Invest* 2013 SEP.
14. Berardono B, Melani D, Ranaldi F, Giachetti E, Vanni P. *Acta Eur Fertil.* Is the salivary "ferning" a reliable index of the fertile period? 1993 Mar-Apr;24(2):61-5.
15. Maurizio Guida, Giovanni A. Tommaselli, Stefano Palomba, Massimiliano Pellicano, Gianfranco Moccia, Costantino Di Carlo and Carmine Nappi. Efficacy of methods for determining ovulation in a natural family planning program. *Fertility and Sterility.* Vol. 72, No. 5, November 1999.

A Review of Robotics in Dental Implantology

Dr. Manju Natarajan¹

Abstract

Technology has become a part of everyday life, whether at home, work or just pretty much anywhere. It is so prevalent that it is hard to imagine a practical life without it. This is true in the field of Dentistry as well where technology is becoming a part of everything that a Dentist or a patient interacts with. This review article aspires to give the reader a robust overview on one part of this technology called Robotics in Dental Implantology. There are many literature articles published on computer-aided or assisted Implantology but none with a focus on robotics exclusively for a specific dental application of Implantology. This paper will give a comprehensive overview of Robotics, its role in Implantology, types of Robotics in use in Implantology thus far and its impact on Implantology.

Key Words: Robotics, Dental Implants, Periodontitis.

¹ B.D.S – Tamil Nadu Government Dental College, Chennai;
M.S - Master of Science in Health Sciences, Merrimack College, Massachusetts, USA

Introduction

According to National Aeronautics and Space Administration (NASA), Robotics is the study of robots which are machines that can be used to do tasks either by themselves or have a person telling them what to do¹. Current Robotic technology has increased its abilities such as precision, sensing, repeatability and controls which makes it more suitable in the field of medicine². In the past, robotics was used in cleaning floors, washing equipments and delivering hot meals to patient's bed but its use has been extended to assist surgeries and surgical planning³. In Dentistry, robotics has not seen a widespread application like other fields. Some of the known dental applications of robotics are; as teaching aids for dental students to simulate real patients, dental surgery and Implantology to include image-based simulation of implant surgery and drilling. While more research and trials are being carried out to fully exploit the benefits of robots from enabling and improving accuracy of dental procedure to may be fully replacing dentists in the future, the discussion in this paper will focus on how robotics are being applied in Implantology

Role of Robotics in Implantology

Although dental implants date back to thousands of years, it wasn't a major breakthrough until the 1980s. Many medical research teams in the 1990s used interactive computer applications including hardware and software as an aid for implant planning⁴. For instance, SIM/PLANT a computer guided implant treatment was the first commercially released software in 1993 which provided the clinicians with the ability to view and interact with the CT scan data to pre-surgically place the implant body and visualize the prosthodontic implications virtually at the same time⁵. In the late 1990s, it was robotics that extended the application from pre-surgical plans into mainstream surgery through automated monitoring of surgical procedures via sensors⁴. Fast forward to 2017, a

Chinese robot dentist successfully fit implants in patient's mouth without any human involvement.

Despite Implantology being considered one of the hottest fields in Dentistry, complications due to human errors are inevitable. Damage to adjacent nerves and improper placement are the most common complications of Implant dentistry⁶. A summary of human error caused in implant surgery are:

- Damage to crown or the roots of adjacent teeth. As a result a root canal or apicoectomy is needed to repair the injured tooth roots.
- When implant surgery is done on the lower jaw, inferior alveolar nerve may get damaged which causes pain, numbness or tingling in teeth, gums, lips, tongue or chin. The same symptoms can occur when the implant is placed right on top of the nerve which causes severe pain when chewing. If the nerve damage fails to heal by itself, then the implant may have to be taken out.
- Drilling through the jawbone into the sinus cavity is another complication during implant surgery.
- Sometimes, fracture of the jaw may occur if there is not enough bone or bone density.
- Pressure and trauma of the soft tissue around or under the implant due to improper placement or size of the abutment and crown restoration which may aggravate implant complications.

These complications arise due to the fact that the Dentist stray away from the correct location, depth and orientation of the plan while still controlling the actual drill delivery which requires extra-ordinary skills of the Dentists. Technology especially robotics or robot-assisted Implantology has been seen as a solution as it would eliminate the burden of Dentists and Patients. As mentioned earlier, while there are many technological advancements that aid Dentist in Implant surgery, this paper will focus specifically on Robotics and its application.

Robotic application in Implantology can be broadly classified into Robot-assisted Implantology and fully-autonomous Implant Robots. A Robot-guided Implantology increases accuracy and aesthetics in dental implant procedures through visual and physical guidance and a simple digital workflow⁷. A fully-autonomous implant robot on the other hand is independent under the supervision of a Dentist⁸.

Robot-guided Implantology

Robot-guided Implantology is spearheaded by Neocis, a company based in the United States of America (Miami, Florida, USA). Founded in 2009, this organization has been approved by Food and Drug Administration (FDA) to use its flagship product "Yomi" with real-world patients in a clinical setting⁹.

According to the consortium on cognitive science instruction, a robot has three basic components; sensors, effectors and control systems¹⁰. Sensors help robots gather information about the environment to guide its actions. Some of the commonly used sensors are microphones, buttons, cameras etc. An effector of the robot is the one that actually does the work. An example of effectors is robotic arms helping a surgeon pick a surgical knife. Control system also known as the brains of the robot determines the behaviour of the robot. Yomi in its simplest form consists of these three basic components.

The primary input to the robot-guided Yomi comes from a CT scan. The CT information is then fed into dynamic planning software that allows the surgeon plan the surgery accounting for key anatomical features like the nerves, sinus and adjacent teeth¹¹. This step sets the parameters of the implant surgery and establishes limits for visual and physical guidance. As shown in Figure 1, visual guidance is a real time three-dimensional graphics that provide navigation during surgery and confirms progress. Physical guidance is provided by the robotic arm (Figure 1) which guides the surgeon to position and drill till appropriate depth.

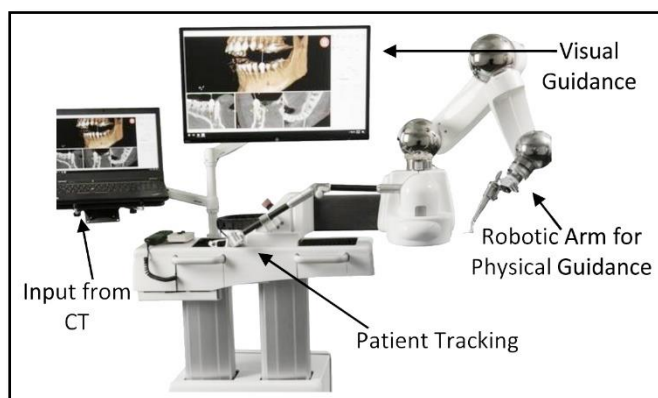


Figure 1: Yomi: Robot-Guided Implants

This collaborative robotic arm enables minimally invasive surgery which leads to faster surgery, faster recovery and less pain for the patients. The robotic arm physically constraints the surgeon's drill movement to match the plan through Haptic guidance technology. Yomi prevents any deviation from the plan with full view of the surgical site. The surgeon precisely drills into the osteotomy and is stopped when reaching the planned depth. Patient tracking throughout the surgery is done through intra-operative tracking that maintains accuracy throughout the surgery and follows the patient if they move.

Robot-guided implants like Yomi comes with its own merits and limitations. Advantages include extremely high accuracy and precision, stable and untiring repeated performance and ability to accurately process quantitative information fed into the system¹². Limitations include the fact that the judgment of the situation is limited to the data fed into the software and/or tracked by patient tracking system, supervision by an experienced Dentist is still required and the cost of the system is prohibitive¹².

Fully-Autonomous Robotic Implantology

Chinese Robot dentist made headlines in 2017, when it successfully fitted two new teeth into a woman's mouth (Figure 2)¹³. The one hour procedure resulted in implant fitted within a margin of error of 0.2-0.3mm. The artificial teeth the robot implanted were created by 3D printing which is another breakthrough technology gaining popularity among Dentists since early 2000s¹⁴.

This fully-autonomous surgery by a Robot being the first of its kind, it involved a lot of planning and multiple Dentists supervision. The dental staff fitted position orientation equipment to the patient and the robot was programmed to move into the correct position to carry out the surgery in a pre-determined movements, angle and depth needed to fit the new teeth. The robot adjusted its positions in-line with patient's own movement. The functioning, process and set up is very similar to Robot-guided Implantology discussed above with the exception that in an ideal implementation a fully-autonomous robot will require minimal to zero Dentist involvement.

This fully autonomous Robot took four years to develop jointly by the Stomatological Hospital, based in Xian, and the robot institute at Beihang University in Beijing¹³. The technology is still in its infancy in a demonstration stage when compared to Robot-guided technology which Neocis (maker of Yomi) claims that the units are being sold to Dentists in the USA. Nevertheless the achievement is significant and has set a high bar for Implant technologies being developed.



Figure 1: Robot Dentist fitting two teeth into a women's mouth in China

Impact of Robotics in Implantology

While technology is catching up in Dentistry in comparison to other medical field, Robotics is fairly a very new term in dentistry. Hence, mainstream deployment of Robotics is very limited and so are its evidences in a clinical setting. However, a literature scan for the evidences for success of robotics returned limited scholarly review, so the search was expanded to include robotics and computer-assisted studies which hopefully establishes the building blocks in the evaluation of Robotics in Implantology.

A phantom experiment of image-guided robotics for dental implantation concluded that the system accuracy is comparable to other similar systems for dental implantation with a Fiducial Registration Error (FRE) and Target Registration Error (TRE) values recorded as less than 0.30 mm and 1.42 ± 0.7 mm¹⁵. FRE is a common measure which is the root-mean square error in fiducial alignment between image space and physical space. The estimate of FRE error is an indication of the accuracy of the system's ability to provide guidance to surgical targets for a given case¹⁶. TRE is the measure of displacement of actual probe from the target in a guidance system¹⁷.

In another study of analysis of all of the major data sources including unpublished data in the internet, computer-assisted/-guided/-aided Implantology has been found to overcome the errors encountered during implant osteotomies and positioning precisely¹⁸. In a meta-regression analysis of 2,827 studies to summarize the accuracy and clinical performance of computer assisted implant systems, the mean error was estimated at 0.74 mm (max value of 4.5 mm) at the entry point in the bone and 0.85 mm (max of 7.1 mm) at the apex.

In a clinical study of 102 patients involving 250 implants in armed forces dental clinic in Germany, the patients were treated with a system that allows transfer of virtual planning of implant positions using

cone beam CT data to surgical guide template. The results concluded that in all cases critical anatomical structures were protected and no complications were detected in postoperative panoramic radiographs¹⁹. A flapless surgery plan was realized in 58.1% of the 250 implants¹⁹.

These literatures conclude promising evidences in robotics and many building blocks of robotics such as the computer-assisted Implantology. But, a more mainstream implementation and wider population study should lead to more robotics dominance in Implantology.

Conclusion

In general Robotics and technology lags in Dentistry compared to the pace of technological adoption curve in other major job markets such as industrial and information technology. Dental Implantology however has seen a remarkable adoption of technology evolving from computer-aided surgical planning to fully autonomous. This could be attributed in part to the complexity and human induced errors involved in Implant surgery especially damages caused to adjacent nerves and improper placement of implants. Robotics has seen its application in the automation of either a portion or all of the implant surgical process in a Dental office. Robotics-guided Implantology, that is partial automation of implant procedure, is more advanced from a technology maturity stand-point. The Dentist is still in control of the process and it minimizes patients' burden. Fully-autonomous robotic Implantology has surely gained interest but the technology is still in its infancy and it is expected to stay that way for the foreseeable future. Irrespective of the type of robotics, the benefits seen in error reduction and in minimizing patient burden will outweigh the cost associated with this technology for some of the developed economies such as US and Europe. According to the Oxford university study, the job of a Dentist is one of the top 10 jobs that a robot will never replace with only a 0.4% of a chance of automation²⁰. This paper did find evidences that could push the limits of the validity of this study by a tiny bit. Whether the risk is seen to the profession or not, the entire dental community can agree to the fact that Robotics will surely have a positive impact on Patients.

References

1. Dunbar B. What Is Robotics? NASA. https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what_is_robotics_k4.html. Published May 18, 2015. Accessed December 30, 2017.
2. Suthakorn, Jackrit. "Robotics in Medical Applications." ISBME (2004): 93-94.
3. Veerabhadram P. Applications of Robotics in Medicine. International Journal of Scientific & Engineering Research. 2011;2(8)

4. Azari A, Nikzad S. Computer-assisted implantology: historical background and potential outcomes—a review. *The International Journal of Medical Robotics and Computer Assisted Surgery*. 2008;4(2):95-104. doi:10.1002/rcs.188.
5. Verstreken K, Van Cleyenbreugel J, Marchal G, et al. Computer-assisted planning of oral implant surgery: a three-dimensional approach. *International Journal of Oral Maxillofacial Implants* 1996;11(6): 806-810.
6. Dental Implants Complications. <http://www.dental-implants-01.com/dental-implants-complications.htm>. Accessed January 6, 2018.
7. What is YOMI? Neocis. <https://www.neocis.com/meet-yomi/>. Accessed January 6, 2018.
8. Bhat T. How Technology is Shaping the Future of Dental Implants. *Zentist*. <https://blog.zentist.io/how-technology-is-shaping-the-future-of-dental-implants-5e92348fbcab?gi=811f28db1812>. Published October 31, 2017. Accessed January 6, 2018.
9. Yomi, The First Robotic Dental Surgery System Now Cleared by FDA | . Medgadget. <https://www.medgadget.com/2017/03/yomi-first-robotic-dental-surgery-system-now-cleared-fda.html>. Published March 2, 2017. Accessed January 6, 2018.
10. Consortium on Cognitive Science Instruction, Parts of Robots. http://www.mind.ilstu.edu/curriculum/medical_robotics/parts_of_robots.php. Accessed January 6, 2018.
11. What is YOMI? Neocis. <https://www.neocis.com/meet-yomi/>. Accessed January 7, 2018.
12. Yeshwante B, Baig N, Tambake SS, Tambake R, Patil V, Rathod R. Mastering Dental Implant Placement: A Review. *Journal of Applied Dental and Medical Sciences* . 2017;3(2)
13. Robot dentist is first to fit implants without a human touch. *South China Morning Post*. <http://www.scmp.com/news/china/article/2112197/chinese-robot-dentist-first-fit-implants-patients-mouth-without-any-human>. Published September 22, 2017. Accessed January 7, 2018.
14. Ventola L. Medical Applications for 3D Printing: Current and Projected Uses. *Pharmacy and Therapeutics*. 2014;39(10):704-711.
15. Sun X, Mckenzie FD, Bawab S, Li J, Yoon Y, Huang J-K. Automated dental implantation using image-guided robotics: registration results. *International Journal of Computer Assisted Radiology and Surgery*. 2011;6(5):627-634. doi:10.1007/s11548-010-0543-3.
16. Fitzpatrick JM. Fiducial registration error and target registration error are uncorrelated. *Medical Imaging 2009: Visualization, Image-Guided Procedures, and Modeling*. 2009. doi:10.1117/12.813601.
17. Fitzpatrick JM. The role of registration in accurate surgical guidance. *Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine*. 2009;224(5):607-622. doi:10.1243/09544119jeim589.
18. Azari A, Nikzad S. Computer-assisted implantology: historical background and potential outcomes—a review. *The International Journal of Medical Robotics and Computer Assisted Surgery*. 2008;4(2):95-104. doi:10.1002/rcs.188.
19. Nickenig H-J, Eitner S. Reliability of implant placement after virtual planning of implant positions using cone beam CT data and surgical (guide) templates. *Journal of Cranio-Maxillofacial Surgery*. 2007;35(4-5):207-211. doi:10.1016/j.jcms.2007.02.004.
20. Crowe S. 10 Jobs Robots Will Never Replace. *Robotics Trends*. http://www.robotictrends.com/photo/10_jobs_robots_will_never_replace/1. Published June 26, 2015. Accessed January 7, 2018.

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