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Ossifying Fibroma: Report of 2 cases and Review of Literature

Garg R., Gupta V.V

Abstract

Aim: The aim of this article is to identify ossifying fibroma as one of the differential diagnosis of any bony lesion either in maxilla or mandible, irrespective of the age. **Background:** Ossifying Fibroma is a benign fibrous lesion of the jaw bones more often involving mandible as compared to the maxilla. There is a significant controversy regarding the name and the diagnostic criteria of the lesion. **Case description:** The author reports two cases of Ossifying fibroma, one in mandible and one in maxilla in the adult male and female patients, respectively. **Conclusion:** Ossifying fibroma can present itself either in maxilla or mandible as reported here, so it needs to be considered under the differential diagnosis of the bony lesions of the jaws. **Clinical Significance:** The clinical features, radiological features and differential diagnosis of this fibro-osseous lesion have been presented in this article.

Keywords: Ossifying Fibroma (OF), Cementifying Fibroma (CF), Fibro-Osseous Lesions (FOL), Jaws

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Introduction

Ossifying fibroma is a benign bony lesion affecting the jaw bones and considered as a subdivision of fibro-osseous lesions. The origin of this benign lesion is from the fibroblasts of periodontal ligament, and it is composed of either cementum, bone, or fibrous tissue. In 1971 fibrous dysplasia, ossifying fibroma (OF), cementifying fibroma and cemento-ossifying fibroma were first classified by WHO as cementum- containing lesions. (Pindborg JJ, 2013)

According to the second WHO classification, benign fibro-osseous lesions in the oral and maxillofacial regions were categorized under 2 subdivisions: osteogenic neoplasms and non-neoplastic bone lesions; cementifying ossifying fibroma belonged to the first category. (Reichart PA, 2006) However, in year 2005 the term “cementifying ossifying fibroma” was replaced by ossifying fibroma by WHO. Branon and Fowler were the first to use the term ‘ossifying fibroma’ (OF) in place of COF. (MacDonald-Jankowski DS, 2009)

Case Description

Case 1

A 55-year-old male patient came to the department of Oral medicine and Radiology with the chief complaint of painless mass over the right side of face since 4 years and associated with pain since 15 days.

His history of present illness revealed that there was avulsion of teeth in the similar same region due to trauma in an interpersonal fight (sustained during a fist fight) 4 years back. Few days after the exfoliation of teeth, patient noticed a small swelling in that particular region which gradually progressed to the present size over a period of 4 years, associated with restricted tongue movements and tingling sensation of overlying skin since 1 year. Patient has not taken any consultation before coming to our department. Patient's Past Medical and Dental History was non-contributory. Personal History revealed that patient cleans his teeth once daily with finger and native powder, and no adverse habits.

General Physical Examination revealed no significant findings.

Extraoral Examination of the patient revealed significant facial asymmetry because of the presence of a large swelling over the right lower third of face. Solitary swelling measuring measured about 10×5 cms in size, and was roughly oval in shape. It extended Extending supero-inferiorly from ala-tragus line to 1 cm below the lower border of mandible, and antero-posteriorly from the philtrum of the lip to the right angle of mandible. Margins were well defined with overlying skin appearing stretched and shiny with no visible pulsations. (Fig. 1)



Figure 1

On palpation, all inspeactory findings were confirmed. Swelling was non-tender with no local rise in temperature. It was firm to hard in consistency and fixed to underlying tissues with no palpable pulsations.

Right and left sub-mandibular lymph nodes were enlarged, palpable, tender, firm in consistency but mobile.

On intraoral examination a flattened solitary swelling was present over the right lower alveolar ridge extending from mid-line to the retro-molar area and medio-laterally extending from floor of the mouth to the right lower alveolar ridge restricting tongue movements. Swelling was approximately 10×5 cms in size with well-defined margins.

Overlying mucosa appeared (Maintain tense) erythematous with areas of ulcerations and whitish slough, probably due to trauma from the opposing teeth. On palpation, all inspeactory findings were confirmed. Swelling was tender on its superior aspect and firm to hard in consistency. Swelling was non-mobile as it was fixed to underlying tissues. (Fig. 2)



Figure 2

On hard tissue examination there were clinically missing 44, 45, 46, 47, and 48. There was significant with grade 2 mobility i.r.t. 42, 43 with generalized stains and calculus. Based on the history, duration of the lesion, signs and symptoms and thorough clinical examination of the lesion, a provisional diagnosis of central ossifying fibroma was made.

Central odontogenic fibroma, Ameloblastic fibroma, and Odontogenic myxoma were considered in the differential diagnosis. All blood investigations were in the normal range and patient was HIV non-reactive.

OPG, lateral oblique view of the mandible and Mandibular occlusal view radiographs were taken for the patient. OPG revealed presence of well defined, mixed radiolucent & radio-opaque lesion over the right side of the mandible, approx. approximately 10×5 cms in size, extending from the left para- symphysis region to 1 cm anterior the right angle of the mandible. Radiographic Border of the lesion was well defined in the anterior aspect and was ill-defined in the posterior aspect, and scalloped. Internal structure of the lesion in the radiograph was of mixed radio density with presence of two coarse C-shaped septa at right angles to each other. Presence of wispy trabecular pattern could also be appreciated. There was displacement of 42, 43 with root resorption and loss of lamina dura in relation to (expand) 43. There was destruction of inferior alveolar canal and downward bowing of the lower border of the mandible. (Fig. 3)



Figure 3

Lateral oblique view (body projection) revealed presence of thick, coarse septa and numerous trabecular wispy pattern. Mandibular occlusal radiograph (Cross-Sectional View) revealed significant buccal (case) and lingual cortical plate expansion could be appreciated with numerous flocculent densities of varying sizes. (Fig. 4)



Figure 4

Based on the radiographic findings, differential diagnosis of central giant cell tumour, focal cemento - osseous dysplasia, and ameloblastoma were made.

Considering it to be the case of ossifying fibroma, patient was referred to oral surgery department, and surgical resection of the lesion was done and specimen was sent for histopathological examination.

H/P report revealed presence of stratified squamous epithelium, with dense fibrous connective tissue stroma. Presence of numerous spindle shaped cells and focal areas of cementum-like substances (cementicles) were distributed uniformly throughout the connective tissue (Fig. 5) A Final diagnosis of central ossifying fibroma of right lower alveolar ridge was given.

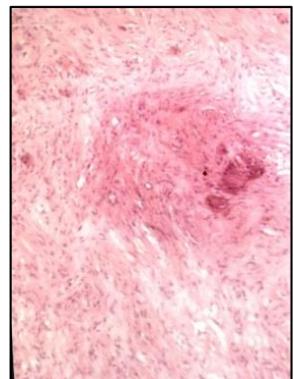


Figure 5

Case 2

A 50-year-old female patient visited the clinic with the chief complaint of painless swelling on the left side of face since 5-6 years. She gave history of avulsion of the teeth 26, and 27, 1 year ago. Her extra oral examination revealed gross facial asymmetry due to swelling over the left side of maxilla. Intraoral examination showed ill-defined swelling over the left side of the palate and the left upper buccal vestibule. The size of the swelling was approximately 4x5 cms in size, extending from the anterior region up to the molar area. The overlying mucosa appeared normal with no secondary changes. On palpation, the swelling was firm to hard in consistency and non-tender. There was grade III mobility in relation to 24, and 25. (Fig. 6)



Figure 6

Considering the age of the patient, history and clinical presentation of the lesion, a provisional diagnosis of central ossifying fibroma was made. Patient was subjected to blood investigations, which were within the normal range.

As the swelling was in the maxilla, Water's view radiograph was taken for the patient which showed significant radiopacity of the left maxillary sinus region. (Fig. 7)

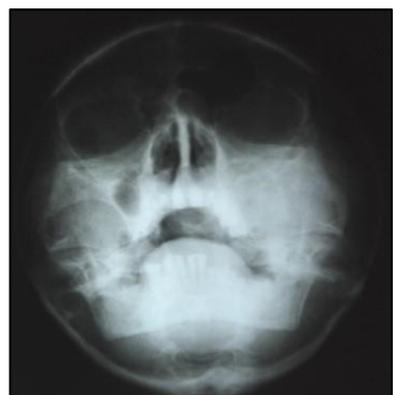


Figure 7

OPG of the patient revealed presence of ill-defined radiopacity in the left alveolar ridge region. (Fig. 8)



Figure 8

After the radiographic and laboratory investigations, patient was referred to the Oral Surgery clinic for surgical resection of the lesion. Histopathological report revealed presence of numerous cementum like structures with in the connective tissue. So, final diagnosis of Central ossifying fibroma of the left upper alveolar ridge was made for this case.

Discussion

Fibro-osseous lesions (FOL) are a diverse group of lesions which consists of fibrous connective tissue interspersed with either bone or cementum-like material. Numerous classifications have been put forward in the literature for fibro-osseous lesions. Eversole et al. (2008) came up with the new classification correlating the clinical, histopathological and radiological features of FOLs.

<p>Inflammatory/reactive processes</p> <ul style="list-style-type: none"> a. Focal sclerosing osteomyelitis b. Diffuse sclerosing osteomyelitis c. Proliferative periostitis 	<p>Neoplastic lesions (ossifying fibromas)</p> <ul style="list-style-type: none"> a. Ossifying fibroma b. Hyperparathyroidism jaw lesion syndrome c. Juvenile ossifying fibroma <ul style="list-style-type: none"> i. Trabecular type ii. Psammomatoid type d. Gigantiform cementomas
<p>Bone dysplasias</p> <ul style="list-style-type: none"> a. Fibrous dysplasia (Monostotic, Polystotic, Polystotic with endocrinopathy, Osteofibrous Dysplasia) b. Osteitis deformans or Pagets disease c. Pagetoid heritable bone dysplasias of childhood d. Segmental odontomaxillary dysplasia 	<p>Cemento-osseous dysplasias</p> <ul style="list-style-type: none"> a. Focal cemento-osseous dysplasia b. Florid cemento-osseous dysplasia <hr/> <p>Metabolic Disease: hyperparathyroidism</p>

Classification of Fibro-osseous lesions by Eversole (2008)

The pathophysiology of ossifying fibroma remains unknown. It is thought to be related to the defects in the maturation of the dental tissue leading to impaired formation of bone or cementum. Barrier and Thompson speculated that the infection in the periapical area with subsequent fibrosis stimulates the PDL membrane to induce the formation of this lesion. The bone morphogenetic protein in PDL membrane is considered to be behind the etiology of this lesion according to Yang et al (Trijolet et al., 2011). The balanced translocation with recurring breakpoints at Xq26 and 2q33 chromosomes is thought to be behind the occurrence of this lesion according to Sawyer JR et al. (1995)

Ossifying fibroma (OF) shows significant variation in the clinical presentation of the lesion in the mandible and maxilla. Ossifying fibroma is a slow growing, expansile lesion of the bone involving either of the jaws. It is more commonly seen in the elderly (3rd-4th decade) females with ratio of

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1:5. In the mandible it typically involves the premolar and molar region superior to inferior alveolar canal. In the maxilla it occurs most often in the canine fossa and zygomatic arch area. (Stuart C. White, 2009)

Smaller lesions seldom cause any symptoms and are detected only on routine radiographic examination. Size of the lesions can vary from 0.2 – 11 cms. Larger lesions are associated with significant asymmetry, mobility and displacement of teeth. In the present case involving the mandible, there was significant displacement of teeth with no associated paresthesia.

It was Eversole LR (1985) who described the two significant radiographic appearance of Ossifying fibroma:

- Expansile unilocular radiolucencies and
- Multilocular lesion

Radiographically, the lesion shows varied radiographic appearance depending upon the amount of mineralization with in the lesion. The density of the lesion is mixed. The internal structure may be a mixture of radiolucent and radiopaque tissue. It tends to expand in all directions equally resulting in the expansion of the outer cortical plate of bone. Although the outer cortical plate gets thinned out, there won't be rupture of the plate. The expansion of the lesion can result in displacement of teeth or inferior displacement of the inferior alveolar canal. There can be significant resorption of the roots of the involved teeth with loss of lamina dura. (Liu Y et al. 2010)

MacDonald-Jankowski (1998) described three stages of OF, based on the radiographic features:

- Osteolytic Stage (42%) which is initial radiolucent stage
- Osteolytic – Osteoblastic Stage (34%) and
- Osteoblastic Stage (24%)

There is always a controversy regarding the lesions to be included in the differential diagnosis of OF. Fibrous dysplasia is usually considered first in the differential diagnosis. It presents as an ill-defined lesion blending with the surrounding bone with a ground glass appearance in the radiograph. Ossification pattern of fibrous dysplasia is irregular which is in contrast to OF. Fibrous dysplasia rarely resorbs teeth. (Carrillo R, 1991)

It is difficult to differentiate fibrous dysplasia from OF when it involves the maxillary antrum. Fibrous dysplasia usually displaces the lateral wall of the maxilla into the maxillary antrum, maintaining the outer shape of the wall, whereas an ossifying fibroma has a more convex shape because it extends into the maxillary antrum. (Stuart C. White, 2009)

One of our cases also shows complete opacification in the maxillary sinus region.

Among the osseous dysplasias, focal osseous dysplasia (FOD), in early, intermediate and late stage, is an important differential diagnosis for OF. FOD is seen in 4th-5th decade of life with ill-defined radiographic borders. FOD lesions do not expand as COF. Other lesions with which OF can be

associated with may include other cemental lesions, aneurysmal bone cyst and Paget's disease. (Su L et al, 1997)

Apart from the fibro-osseous lesions, other diseases may be included in the differential diagnosis of OF. In early radiolucent phase of OF, odontogenic cysts, ameloblastoma, central giant cell lesions, chronic apical periodontitis and idiopathic bone cavity can be considered. For mixed lesions, osteoblastoma, calcifying cystic odontogenic tumor and calcifying epithelial odontogenic tumor should be considered in the differential diagnosis. Finally, for radiopaque phase of OF, complex odontoma and idiopathic osteosclerosis are the main differential diagnoses. OF may also resemble a cementoblastoma if it occurs around the tooth root. (Marcia de Andrade et al, 2013)

The late Charles Waldron CA (1993) wrote “in absence of good clinical and radiologic information a pathologist can only state that a given biopsy is consistent with a FOL. With adequate clinical and radiologic information most lesions can be assigned with reasonable certainty into one of several categories”.

Histologically, bone and cementum are two microscopically distinct entities, but the origin of cementoblasts and osteoblasts appears to be the same. Microscopically, this neoplasm is composed of a proliferation of benign spindle cells, forming a cellular connective tissue and a mineralized tissue similar to bone or cementum. (Moraes de Ramos-Perez FM, 2010)

Juvenile trabecular ossifying fibroma (JTOF) and juvenile psammomatoid ossifying fibroma (JPOF) are other histological variants of OF. In contrast

with conventional OF, these lesions occur most commonly in the maxilla and bony walls of paranasal sinuses, respectively. Both present predilection for patients up to the second decade of life. JTOFs usually show an aggressive and rapid growth, different from the ones in the current study. (Slootweg PJ, 1995)

The treatment of ossifying fibroma is complete removal by curettage or excision. Resection must be complete to prevent recurrence. The ossifying fibroma frequently presents a cleavage surface with healthy bone, therefore making it accessible to enucleation followed by curettage of the residual cavity. (Eversole LR 1985)

Conclusion: Central Ossifying Fibroma can mimic numerous other bony lesions of the jaw bones, so a prompt correlation between clinical, radiological and histopathological findings is mandatory to arrive at a definitive diagnosis.

Clinical Significance: At the end of this article, readers will be able to differentiate Central ossifying fibroma from the other bony lesions clinically as well as radiographically.

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Figure Legends

1. Extraoral picture of 1st case showing gross facial asymmetry
2. Intraoral picture showing the extent of the lesion on the lower right alveolar ridge.
3. OPG showing mixed radiolucent-radiopaque lesion over right side of mandible.
4. Mandibular occlusal radiograph showing bucco-lingual cortical plate expansion.
5. H/P report showing presence of spindle shaped cells and cementum like material.
6. Intraoral picture of 2nd case showing swelling on the left side of the palate and buccal vestibule.
7. Water's view showing radiopacity over left maxillary sinus region.
8. OPG showing radiopacity over the left side of the maxilla.

Effect of Forced Blinking on Tear Meniscus Height During Contact Lens Wear

Kuan N.K., Barodawala F.S

Abstract

The present study was carried out to determine the tear meniscus height pre and post forced blinking during contact lens wear. Subjects who were non-contact lens wearers and free from any ocular pathology were included. Selected subjects were fitted with a daily-disposable silicon hydrogel soft contact lens with a power of -1.00DS. Thirty-four (34) subjects who achieved an optimum fit with the daily disposable lens were tested for their tear meniscus height (TMH) measurements. The TMH were measured using Oculus Keratography K5 before and after one minute of forced blinking during lens wear. Subjects consisted of 20 females (59%) and 14 males (41%). The mean age of the subjects was 22.24 ± 2.50 years. The mean TMH before and after force blinking was 0.19 ± 0.03 mm and 0.21 ± 0.03 mm respectively. Paired t-test showed a statistical significant difference in the TMH before and after forced blinking $t(33) = -6.21$ ($p < 0.05$). There was an increase in the TMH after one minute of forced blinking during contact lens wear. Forced blinking exercise are likely to alleviate many of the sign and symptoms of ocular discomfort and dryness during contact lens wear.

Keywords: Tear meniscus height, Forced blinking, Contact lenses

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Introduction

Tears are important not only because it acts as a defence mechanism but also prevents foreign element from entering our eyes and nourishes the cornea (Xu et al., 1994). Tears also play an important role in maintaining the ocular comfort during contact lens wear. Thus, stability and the overall function of the tears film should be well maintained. One of the way is by blinking. According to Jane et al., (2016), the mechanism of tears while blinking is described as “Firstly, the lipid layer is squeezed between the inferior and superior lid when the eye closes. Secondly, tear duct produced mucin and lipid from the tear film and they moved along the inferior and superior fornices. Thirdly, a new layer is produced by lid compressing against the surface of the eye. When eye opens up again, hydrophilic epithelial surface produces a new layer of aqueous. Lastly, lid closure allows the lipid to squeeze into a thick layer, spreads evenly and secrete a new layer across the aqueous to maintain the function of the eye.”

Dry Eye Syndrome (DES) is a common ocular disease which alters the quality of life as it causes visual discomfort and damage to our eyes (Gajta et al., 2015; Kastelan et al., 2013; Oguz et al., 2000). At the 2007 International Dry Eye Workshop, the definition of the disease was reviewed and rephrased as “Dry eye is a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface” (Potvin et al., 2015).

Tear film and ocular surface area is affected by blinking. Incomplete or partial blinking will leave the exposure area to dry up and cause ocular discomfort. Thus, blinking is important to maintain the ocular surface area and protect it from evaporation. Holland and Tarlow (1975), stated that blinking is related to cognitive process. Blink rate is low during mental activities like solving arithmetic tasks or daydreaming. Contact lens often reduce tear film quality and contact lens wearer are more prone to incomplete blinking (Rosenfield, 2011). As a result, tear film is not fully renewed. Voluntary blinking exercise such as forced blinking may help to renew tear film and improve ocular discomfort.

Tear meniscus height is a measurement of tear meniscus volume. According to Bitton et al., (2010), contact lens wearers have more impact on TMH variations nearly at the end of the day after prolong blinking. Non-contact lens wearers also show significant increase in tear meniscus height during the afternoon visit. Mean values of TMH measured were greater in non-wearers compared with contact lens wearers (Miller et al., 2004; Shrestha et al., 2012).

When a contact lens is fitted, pre-corneal tear film (PCTF) is divided into pre lens tear film (PLTF) and post lens tear film (POLTF) (Wang, Cox and Reindel., 2009). PLTF covers the outer surface of CL; provide good wearing comfort and vision (Hager, 2017). POLTF in between the contact lens and cornea surface form a cushion for lens movement after every blinks (Muntz et al., 2015). An unstable PLTF accelerate lens dehydration and deposits formation, lead to poor lens comfort and vision (Richdale et al., 2007). Hydrogel lens wear will have transient reduction of tear stability but there

were no changes in their tear quantity (Faber et al., 1991). Recommendation of silicon hydrogel (SiHy) CL will help contact lens wearer with hypoxia problem. The corneal neovascularization, symptom of dry eyes and limbal redness improved when contact lens wearer switched from hydrogel to silicon hydrogel lenses (Bergenske et al., 2007). Different contact lens material also affect the tear meniscus height and corneal thickness (Del Águila-Carrasco et al., 2017).

Oculus Keratograph K5 was used to measure the TMH as it is reported to have a good repeatability and reliability for the measurements of tears (Baek et al., 2015). Tear volume is imperative to maintain ocular comfort and TMH is one of the measurement.

Methods and material

A clinical cross-sectional study was conducted on thirty-four (34) subjects between the age range of 18 to 30 years old irrespective of their ethnicity and gender. Only non-contact lens wearers having the mean spherical equivalent refractive (SER) error range from +0.75D to -7.00D were enrolled in the study. Subjects having any ocular pathology or disease were excluded from the study.

The research complied with the tenets of the Declaration of Helsinki. Written consent from all subjects were obtained prior to enrollment. A comprehensive eye examination was conducted on the selected subjects prior to carrying out the research tests. Subjects were then fitted with a 1-Day Acuvue TruEye from Johnson and Johnson Vision Care® with spherical power of -1.00DS to achieve an optimum fit. Subjects who did not achieve

an optimum fit were excluded. Pre THM was then measured with the contact lens using the Oculus Keratograph K5 as shown in Figure 1. The measurement scale was aligned to the lower lid margin and then dragged until the top to the margin of the tears. The scale automatically calculated the height of the tear meniscus until the scale is dragged. Subject were then asked to force blink repeatedly for 1 minute. The whole process was recorded and monitored using the Oculus Keratograph K5 to ensure subject is doing the correct procedure. Once the duration of forced blinking was over, the subjects post TMH was then measured again. Data was then collected and analysed using IBM SPSS Statistics Version 24 (Chicago, IL, USA)

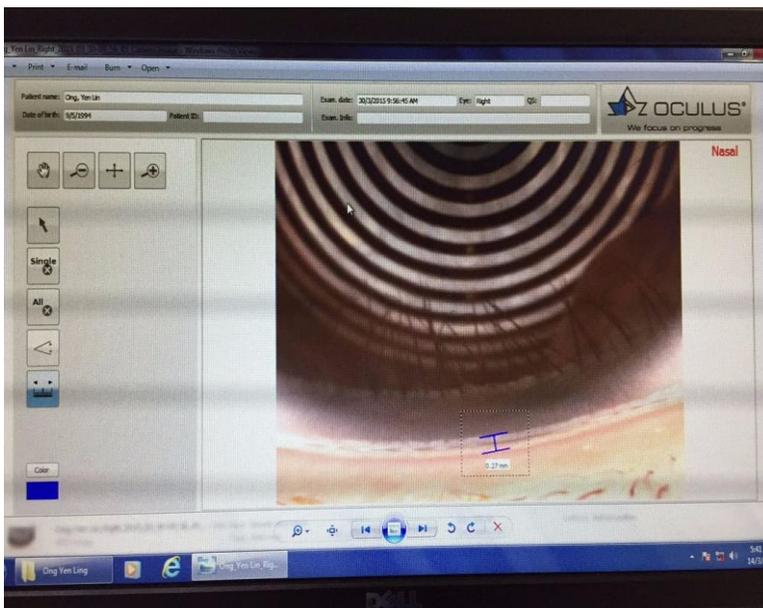


Figure 1: Measurement of tear meniscus height

Results

Thirty-four healthy young adults consisting of 20 females (59%) and 14 males (41%) were enrolled in the study. The mean pre and post TMH measured using the Oculus Keratograph K5 are shown in table 4.1.

Table 4.1: Mean Pre & Post TMH

	Mean	Std. Dev
Pre TMH (mm)	0.19	0.03
Post TMH (mm)	0.21	0.03

Data was normally distributed, hence a paired t-test was carried out to analyse the data. There was a statistical significant difference with $t(33) = -6.213$ ($p < 0.01$). Thus the results shows an increase in TMH after forced blinking.

Discussion

The present study shows there was a significant difference of TMH after forced blinking with contact lens. The average results of pre and post TMH in this study was 0.19 ± 0.03 mm and 0.21 ± 0.03 mm for post tear meniscus. The difference between the two measurements is 0.02mm which may not be clinical significant

Previous study shows that pre and post TMH was significantly higher over the blink interval (Bitton et al., 2010). The mean pre and post TMH reported by Bitton et al., (2010) were 0.17 ± 0.05 mm and 0.24 ± 0.01 mm respectively. The results of the previous study are in agreement with the present study.

Johnson and Murphy (2005) proposed that the rate of increase in TMH lowers with time, primarily due to localized thinning of the tear film next to the meniscus retards the inflow of fluid. This is the reason for standardization of time of forced blink is was set to one minute in the present study across all subjects

Tear meniscus height is an indirect measurement of overall tear volume and are directly correlated to each other (Johnson and Murphy, 2005; Wang et al., 2009). In this study, pre TMH has lower measurement as compared to post TMH. The TMH changes following a blink according to Johnson and Murphy (2005). Previous study also found out that there is no statistically significant difference between inferior and superior tear meniscus from baseline, The mean superior central tear meniscus was $0.21\text{mm} \pm 0.027$. In the present study, pre tear meniscus reading was lower compared to the previous study. The differences could be because of the instrument used to measure the TMH.

Tear meniscus height decreased with contact lens wear as shown by Nagahara et al. (2015). According to their study, significant decrease in TMH were found with both high and low water content hydrogel CL wear. Silicon hydrogel contacts lens were chosen for the present study as previous study by Montés-Micó et al., (2013) conclude that SiHy lenses reduce dehydration due to their low water contents.

According to Baek et al., (2015) and Le et al., (2009), TMH measured with keratography had good repeatability and reliability as compared to OCT. It showed a close correlation between TMH measured with the keratography

and FD-OCT. In the present study, the Oculus Keratography was used and yield repeatable results of distribution changes of tear meniscus effected by forced blinking. Maruyama et al., (2004) reported that change of environmental conditions such as temperature and humidity do not affect the TMH. Previous study has shown statistically higher value of TMH ($0.28 \pm 0.12\text{mm}$) as compared to present study ($0.21 \pm 0.03\text{mm}$). The difference in TMH values may be due to different lens materials such as hydrogels and silicone hydrogel.

Conclusion

There is an increase in the tear meniscus height statistically after forced blinking for 1 minutes during contact lens wears. However the change may not be clinically significant. Thus, further studies are recommended to study the type of blinking normal blinking versus forced blinking on the TMH.

Disclosure

There is no financial or personal interest for any of the brand of products mentioned. No financial grant was utilized for this study.

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A Comparative Study on Colour Vision Using Standard Ishihara Booklet and Smartphone Colour Vision Application on a Laptop Computer

Ronny H.V.T., Batumalai U.

Abstract

Colour vision assessment is usually performed as part of a routine eye examination to diagnose colour vision deficiency and also helps to monitor the progression or remission of a diseases. Besides the cost of the booklet that limits the availability of the test, Ishihara booklets that have been used over the years show natural wear and tear that causes a shift in colorimetric values leading to inaccurate results. This study has been done to evaluate the difference between Ishihara booklet and colour vision smartphone application on a laptop computer. It was a cross-sectional study, which involved a total of thirty-four (N=34) subjects aged between 23.25 ± 1.74 years. Subjects were recruited are the ones that have been diagnosed with colour deficiency. After consent was taken, best corrected visual acuity for distance and near was recorded, power of the subjects spectacle was recorded if any and slit lamp examination was performed to rule out any abnormalities. Ishihara test on booklet and on laptop computer was then performed on subjects where the test to start first was done by block randomization. The plate-identification success rate was calculated and was used for data analysis. The mean plate-identification success rate for Ishihara booklet was 85.83 ± 14.49 and the mean plate-identification success rate for Ishihara application was 87.29 ± 14.37 . Wilcoxon sign rank test showed that there was no significant difference in the individual plate-identification success rate between Ishihara booklet and colour vision application ($p>0.05$), with a moderate kappa measure of agreement ($k=0.45$, $p<0.01$). Hence, colour vision application may be used as alternative to Ishihara booklet. However, further validation of these applications are required.

Keywords: Ishihara booklet, Colour vision application

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Introduction

Colour vision discrimination is important. This is due to various tasks and activities requires ability to differentiate and perceive colours correctly. Colour vision deficiency may occur as a result of congenital or acquired conditions. Colour vision assessment is usually performed as a part of a routine eye examination to diagnose any deficiency and also helps to monitor the progression or remission of diseases.

There are several tests that are available for diagnosing colour vision deficiencies. However, the most commonly test used for rapid screening of congenital and acquired colour vision deficiency is the Ishihara test (Sorkin et al., 2016). The Ishihara test is useful in determining red-green colour defects and also provides diagnosis regarding the dichromatism type such as protan or deutan. (Marey, Semary & Mandour, 2014).

Isihara test is a printed booklet accessible worldwide and yet there are copious adaptation from the original (Oli, Kumar & Joshi 2017). The duplicate copies are very difficult to be discriminated. Furthermore, Isihara booklet is costly which usually causes clinicians to share the booklet each day and this waste significant amount of time (Awad, Natt & Pothier, 2007).

Another study found that the reliability of the Ishihara test plates to determine colour vision deficiency reduces as time passes due to a shift of colourimetric values with plate aging leading to imprecise results (Hyon, Lee & Wee, 2005)

Advancement in Operating system platform technology recently has found its way into the Optometry field (Zvornicanin, Zvornicanin, & Hadziefendic, 2014) creating various software imitating the manual tests done. Currently, there are many applications for colour vision testing on smartphones. Some applications are the direct copy of the Ishihara booklet whereas others are modified (Sorkin et al., 2016). This creates alternative to colour vision booklets that is economical, easy to use, and may show no effect with prolonged use.

With widespread availability of smartphones and computers, there is an increase in smartphone application used to detect for colour deficiency. As far as current knowledge, validation of the smartphone applications are scarce. Thus, in this study we compare the 24-plate edition Ishihara booklet and Android colour vision application among colour deficient subjects.

Materials and Methods

A. Study population

Subjects free from any systemic disease were chosen. Age of 12 years or more regardless of any gender who failed the Ishihara booklet test or else diagnosed as colour deficient were selected. Subjects with best corrected visual acuity of 6/6 at distance and N5 at near were included. Subjects with

acquired colour vision deficiency and binocular vision problems were excluded.

B. Screening Assessment

A consent form was given to each qualified subject followed by a screening assessment.

A brief history was carried out to obtain information about the subject's demographic, last medical check-ups and also the last eye examination. Subject's habitual correction was obtained by using a lens meter (Shin Nippon LM-15D). The habitual visual acuity (VA) was then taken monocularly and binocularly using the Snellen chart at 6 meter and a near reading chart at 40cm. Colour vision assessment was then obtained by Farnsworth D15 test. External and internal eye health assessment was done using the slit lamp. And the fundus examination was done by using the fundus camera (Topcon TRC-NW300 Non-Mydriatic Retinal Camera).

C. Research Test

Subjects that had met the requirements of the screening assessment proceeded to the main study. Subjects was tested with the 24 plates edition Ishihara booklet that is aged 5 years old followed by the colour vision application test. The test given was based on block randomization. Both tests were performed monocularly and binocularly under fluorescent daylight with illumination of approximately 175 lux. The illumination was measured using a lux meter (AMPROBE LM-100). The phone application was used on a computer laptop (Acer Aspire V3-471G) and the screen brightness was set to maximum. Testing distance was fixed at 75cm for both Ishihara

booklet and colour vision application test. Each plate was shown for 3 seconds to be identified. Subjects that exceeded three seconds were considered as unable to identify that particular plate. Plates were presented in an order starting from plate 1 to plate 24.

Results

Twenty subjects with mean age of 23.25 ± 1.74 years (21-25 years) were recruited for this study. 15 (75%) of them were male while 5 (25%) were female subjects.

The mean score of each plate identified correctly by the subjects in the Ishihara booklet and the colour vision application was 85.83 ± 14.49 and 87.29 ± 14.37 , respectively. There was no significant difference exist between Ishihara booklet and colour vision application test ($t(23) = -1.664, p > 0.05$). Table 4.1 shows the success rate of each plate compare between the two tests. All plates showed no statistical significant difference ($p > 0.05$) between Ishihara booklet & colour vision application test. Clinically, only plate number three to plate number five showed lower success rate in colour vision application, whereas in the rest of the plates, colour vision application showed higher or equal success rate in comparison to Ishihara booklet.

	Ishihara Booklet (Mean Success Rate %)	Colour Vision Application (Mean Success Rate %)	P-Value
Plate 1	100	100	1.00
Plate 2	65	80	0.08
Plate 3	60	55	0.66
Plate 4	70	65	0.66
Plate 5	75	70	0.56
Plate 6	90	90	1.00
Plate 7	85	90	0.32
Plate 8	100	100	1.00
Plate 9	100	100	1.00
Plate 10	100	100	1.00
Plate 11	100	100	1.00
Plate 12	100	100	1.00
Plate 13	100	100	1.00
Plate 14	85	90	0.32
Plate 15	85	90	0.32
Plate 16	65	70	0.32
Plate 17	65	65	1.00
Plate 18	60	65	0.32
Plate 19	90	95	0.32
Plate 20	95	95	1.00
Plate 21	95	95	1.00
Plate 22	85	85	1.00
Plate 23	90	95	0.32
Plate 24	100	100	1.00

Table 4.1 Plate identification success rate of the Ishihara booklet and colour vision application

An inter-test reliability analysis using the Kappa statistic was performed to determine consistency among Ishihara booklet and colour vision application. There was a significant moderate agreement between the two test ($k = 0.45, p < 0.01$).

Indication of colour deficiency type (deutan or protan) was successful in only 13 out of 20 patients (65%) in both Ishihara booklet and the colour vision application as shown in Table 4.2. Only seven patients were successfully typed by both tests. Of those seven patients, four were typed by both tests as strong deutan, one as strong protan, and two as mild protan.

No of Subject	24 Plate-Ishihara Booklet	CV Application
1	Not identified	Not identified
2	Strong Deutan	Mild Deutan
3	Not identified	Mild Protan
4	Strong Deutan	Mild Protan
5	Strong Deutan	Strong Deutan
6	Not identified	Not identified
7	Not identified	Not identified
8	Strong Deutan	Mild Deutan
9	Not identified	Not identified
10	Mild Protan	Strong Deutan
11	Strong Protan	Strong Deutan
12	Not identified	Not identified
13	Strong Deutan	Mild Protan
14	Mild Protan	Mild Protan
15	Not identified	Not identified
16	Strong Deutan	Strong Deutan
17	Mild Protan	Mild Protan
18	Strong Deutan	Strong Deutan
19	Strong Deutan	Mild Protan
20	Strong Deutan	Strong Deutan

Table 4.2 Diagnosing colour deficient type among the subjects

Discussion

This study was a comparative study on colour vision using standard Ishihara booklet and colour vision application on a laptop computer. Analysis of the data provided information about the plate-identification success rate

between Ishihara booklet and colour vision application among colour deficient participants. In the current study, the plate identification success rate was not statistically significant between Ishihara booklet and colour vision application ($p>0.05$). Sorkin et al. (2016), conducted a similar study with two different colour vision applications namely, The Eye2phone and the CVT application comparing to the Ishihara booklet. It was found that there was no significant difference between the Ishihara booklet and the Eye2phone application ($p>0.50$) but there was a significant difference found between the Ishihara booklet and the CVT application ($p<0.01$) CVT due to the nature of the test which is difference from the original Ishihara booklet.

The plate-identification success rate in plate number three and plate number five was lower in colour vision application compared to Ishihara booklet while the rest of the plates showed same or higher success rate compared to Ishihara booklet. The issue of colour consistency of various devices may differ could have resulted in the consistency of colour discrepancies (Oli, Kumar & Joshi 2017). In the current study colour vision application test was performed using a laptop computer while Sorkin et al. (2016)'s study used a mobile phone. Difference between colour vision application on a laptop computer and on a phone might affect the outcome of the plate identification success rate in both of the tests as Sorkin et al. (2016)'s result showed better success rate in Ishihara booklet.

According to Kapoor, Vats & Parihar (2013), a difference in contrast and brightness might affect the results of the colour test application. In the current study, the computer screen was set at maximum brightness and placed in a bright room. Both the room brightness and the screen brightness

might have enhanced the chart presented thru the colour vision application resulting in better success rate. Sorkin et al. (2016) on the other hand used a smartphone with maximum brightness, however both set up might have a different luminance.

A study conducted by Sorkin et al., 2016 comparing two different colour vision applications the CVT application and the Eye2Phone application. It was found that there was no significant difference between the Ishihara booklet and the Eye2Phone application with a high kappa measurement and there was a significant difference between the CVT application and Ishihara booklet with a low kappa measurement. This may be caused by the difference of application used as the Eye2Phone is a duplicate of the Ishihara booklet while the CVT is not. While for this study, the kappa measurement was moderate compared to the study conducted by Sorkin et al., 2016. As stated by Vanbelle, 2017, difference in sample size might affect the kappa measurement result. The study conducted by Sorkin et al., 2016 consist of 80 subjects while in this study, there were only 20 subjects recruited hence resulting in difference in kappa measurement result.

In this study, indication of colour deficiency type (deutan or protan) was successful in only 13 out of 20 patients (65%) in both Ishihara booklet and the colour vision application. Only seven patients were successfully identified by both tests. This may be due to the aging of the Ishihara booklet which caused a shift in colorimetric value that affects the outcome of the exam (Hyon, Lee & Wee, 2005; Lee & Honson, 2003). In this study, Ishihara booklet used was aged 5 years and thus might affect the colorimetric value of the booklet. While for the colour vision application, it may be due to the

brightness set to maximum which also causes a shift in colorimetric value (Lee & Honson, 2003). Difference in brightness causes the colours of the digit in Ishihara booklet to be not aligned with the isocolour line and causes the luminance of the digit to differ from the luminance of the background. This will cause the digit that should appear to be vanished may or may not be seen by the colour deficient subject and hence causes a miss-classification or undiagnosed colour deficient type.

A limitation of this study is that the total sample size for colour deficient subjects was not sufficient to fulfil the power of this study which consist of a total sample size of 34 subjects (Nayak 2010). This might cause the result shown to be not significant because of not fulfilling the power of the study. Another limitation is that there was no fixed setting prompt by the application itself such as the working distance required as well as the amount of brightness needed before conducting the test. Electronic applications are also constantly changing and will not guarantee that the application that was used in this study will be permanently available. But due to the application used in this study is an exact duplicate of the Ishihara booklet, there are several applications which are similar to the application used in this study which are currently available. Therefore, the results obtained from this study may be applied to these applications as well, but further studies are required for confirmation of the reliability of the new applications available.

Conclusion

The study concluded that there was no difference in the plate-identification success rate between Ishihara booklet and colour vision application. Hence,

colour vision application may be used as an alternative to Ishihara booklet. However, further validation of these applications is required.

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Alternative Tobacco Use among SEGi University Students-across-sectional Study

Sum C.Y., Chew J.Y., Lim J.Q., Chong W.C., Ramamurthy P., Muttalib K.A

Abstract

The use of alternative tobacco products is on an increasing trend among college and university students in many countries as they are considered to be safe alternatives to cigarette. Unfortunately, these alternative tobacco products can cause serious health consequences.

Aim: To find out the prevalence of alternative tobacco usage among SEGi university students so as to educate them on the health effects of the same.

Methodology: This cross-sectional study was undertaken among students of SEGi University, Kota Damansara. Ethical clearance was obtained from the institutional ethics committee. Eight faculties were selected from the list of faculties using stratified random sampling to include students from both health science and non-health science faculty. Required data was collected using a validated Global Youth Tobacco Survey (GYTS) questionnaire which was administered as google form via email. All data collected were analyzed using SPSS version 22. Descriptive statistics and frequencies were used to interpret the results.

Results: Out of 650 students who were invited to participate, 478 responded. Of them, 97(20%) were tobacco users. Among the participants who used tobacco, about 86% consumed alternative tobacco products, the highest being shisha followed by vaping.

Conclusion: There is a high prevalence of alternative tobacco use among the tobacco users in the present study. There is a need for strict reinforcement of tobacco policy in the campus and awareness programme for the students on the health effects of alternative and multiple tobacco use.

Keywords: Alternative Tobacco Products, Students, Prevalence, Shisha, Vaping

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Introduction

Tobacco epidemic is one of the biggest threats to public health, the world has ever faced, killing more than 7 million people a year. While the use of tobacco is on a decreasing trend in developed countries, it is increasing in developing countries. This is partly due to the global tobacco industry's marketing strategy targeting young adults in developing countries.¹ Alternative tobacco products (ATP), which include cigars, chewing tobacco, snuff (smokeless tobacco), hookah (water pipe), etc, are highly available in the market and are increasingly being promoted as potentially less harmful cigarette alternatives ². This claim of reduced harm may encourage the use of other tobacco products in addition to or as a substitute for cigarettes. However, all of these tobacco products contain carcinogens and are associated with important health consequences. ³

Studies have shown that ATP use occurs more often in combination with cigarette smoking than in isolation. Multiple tobacco product uses among adolescents and young adults may promote and reinforce nicotine addiction, which in turn, may result in them being poly-tobacco users when they grow up to be adults.⁴ It may also lead to problematic behaviour due to their

underlying tendency to non-conformity or deviance.⁵ Young multiple tobacco product users are also more likely to engage in binge drinking, illicit drug use and excessive gambling.^{6, 7}

The use of ATPs has become common among university students due to many factors such as parental smoking, peer pressure, easy availability, increased promotion, etc.⁸ Though there are many studies on tobacco usage in Malaysia, there are no studies exploring ATP usage among university students. Hence this study was undertaken to know the prevalence of alternative tobacco usage among university students and to educate them on the health effects of the same.

Methodology

This cross-sectional study was undertaken as part of a study to assess the patterns of tobacco use and its effects on oral health among students of SEGi University, Kota Damansara. Ethical clearance was obtained from the institutional ethics committee, along with necessary permissions from the deans of all the included faculties, for collecting required information from their respective students. Informed consent was obtained from all the participants of the study. Eight faculties were selected from the list of faculties using stratified random sampling to include both health science and non-health science faculty. All the students of these eight faculties, without any bar for age or gender were invited to participate. Students who did not give consent were excluded from the study.

Data was collected using a validated Global Youth Tobacco Survey (GYTS) questionnaire which included both close-ended and open-ended questions.

The questionnaire included sections on demographic details like age, gender and ethnicity, knowledge and attitude about tobacco use which included their awareness on types of tobacco products, their harmful effects etc, and practices pertaining to cigarette, and other alternative forms of tobacco use which included types of tobacco used, frequency, duration, time, associated health problems etc. The survey form was administered as google form for the participants to fill, via email. Participants were given one month time to fill up the questionnaire.

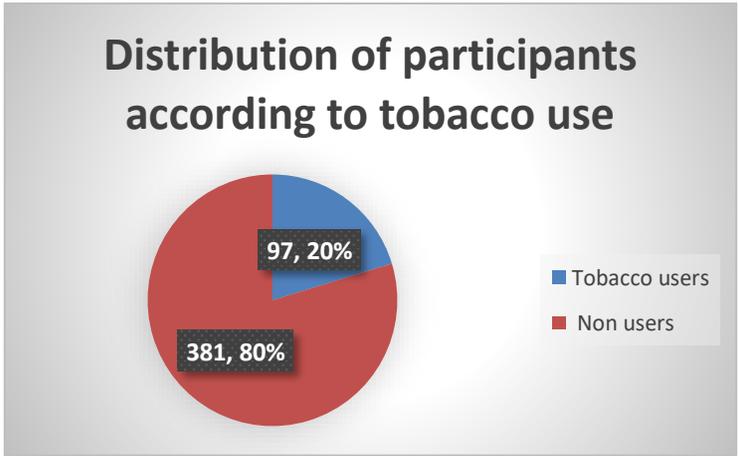
All data collected were analyzed using SPSS version 22. Descriptive statistics and frequencies were used. Tabular and graphical displays were used to present the final results.

Results

A total of 650 students were invited to participate. Out of them, 478 responded resulting in response rate of 73.5%.

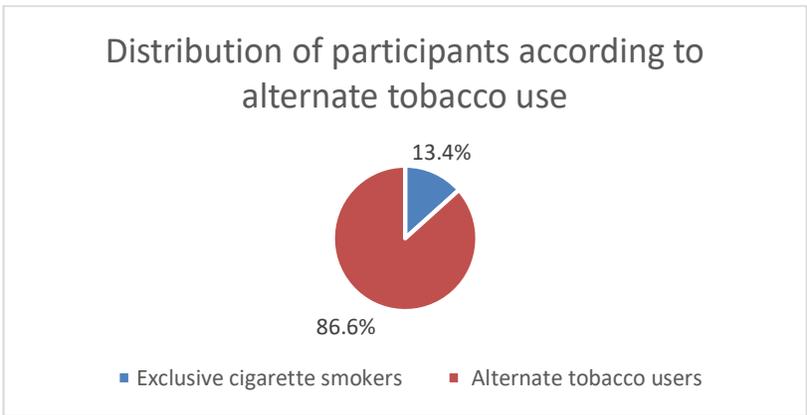
Table 1 shows the demographic distribution of the participants

Demographic Factors		Percentage (%)
Age Group	26-30 years	1.0
	21 – 25 years	52.1
	16 – 20 years	46.9
Gender	Male	32.8
	Female	67.2
Ethnicity	Malay	16.5
	Chinese	65.1
	Indian	10.7
	Others	7.7



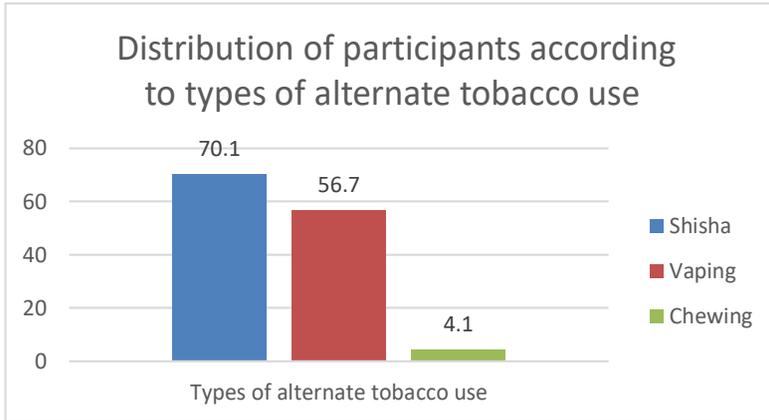
Graph 1: shows the percentage of students using tobacco in any form

Out of 478 students who took part in the study, 97 (20%) were tobacco users.



Graph 2: Shows distribution of tobacco users according to alternate tobacco use

Out of 97(100%) of the tobacco users, about 13.4 % were exclusive tobacco users and 86.6% used alternative tobacco products. Among alternative tobacco users, 18% used them alone while 82% used them in combination with cigarette.



Graph 3: shows distribution of participants according to type of alternate tobacco use

Among the students using alternative tobacco products, about 70% used shisha, 57% used vaping and about 4% used chewable tobacco.

Discussion

ATPs are products other than cigarettes or cigars that contain tobacco.⁹ They include e-cigarettes, hookah, loose leaf, pellets, plug, twist, bidis, kreteks, snuff, dokha, gutka, naswar and snus.¹⁰ Such products can result in health threats such as tumors, coronary illness and cancers due to the presence of chemicals and poisons. ³

In our study, about 20% of the participants used tobacco, out of whom about 86% used alternative tobacco products. This means that in our study, the prevalence of alternative tobacco use is about 18% overall. Studies have shown an increased prevalence of ATP use among university students in many countries. A study conducted at a university in Ajman revealed that

10.1% of the study participants used ATPs. A study conducted in the US showed that 18% of the participants used ATPs. 11 A study in Argentina revealed that about 24.1% of the population used ATPs.10

Among the alternative tobacco users in our study, about 82% of them used alternative tobacco products in conjunction with cigarette smoking indicating the prevalence of multiple habits among the participants. Studies done in the past have shown that ATP use occurs more often in combination with cigarette smoking than in isolation.12 Concurrent users experience higher intermediate levels of mortality, are more likely to ingest more nicotine on a daily basis, are less likely than single-form users to stop using tobacco and are at higher risk for acute myocardial infarction.13 Thus, the consequences of using multiple forms of tobacco may be additive or synergistic.12

Among the alternative products used by the participants of our study, about 70% used shisha followed by 56% of vaping and only 4% chewed tobacco. The reason for this high prevalence of shisha could be the easy accessibility, as many shisha bars are located within 500 meters around the vicinity of the university. In a study on university students in Syria, a high percentage of students used shisha as they were attracted to its smell and flavours.14 In a study conducted in Ajman, participants felt that shisha bars were places of socialization where they could blend with friends.8 Shisha, a form of tobacco smoking in a water pipe, has emerged as a global public health concern and has been described as the ‘emerging deadly trend.15 Electronic cigarettes (or e-cigarettes) on the other hand are electronic devices that can deliver nicotine in aerosol form without burning tobacco. Their use is

increasing worldwide 16, 17 and is more common among current smokers and former smokers than never-smokers as many consider it as a safe alternative to cigarettes as there is no burning of tobacco. 18,19 In our study, only about 4% of the users used chewing tobacco indicating a comparatively lower percentage as against other smoking forms. A study among students in North Carolina also showed a lower prevalence of 7% of chewing tobacco use.²⁰

Another reason for using alternative tobacco products could be the fact that most existing tobacco control interventions primarily address cigarette smoking and do not address the use of other tobacco products.²¹ Hence, future tobacco control programs may be required to target increasingly other forms of tobacco use, given the recent proliferation of alternative tobacco products such as hookah and e-cigarette use, even at a local set up like a university.

Conclusion

Our study showed a prevalence of 18% alternative tobacco usage among the study participants. A detailed study is further required to explore the factors associated with the same. There is a need for strict reinforcement of tobacco policy in the campus and awareness programme for the students on the health effects of alternative and multiple tobacco use.

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A Comparative Study of Chinese Text Orientation (Horizontal and Vertical) on Reading Speed

Tan X.Y., Batumalai U.M

Abstract

Text orientation has been found to be one of the factors that affect the reading speed. This study was carried out to investigate the reading speed between horizontal and vertical text direction by comparing the reading speed between both text directions. Thirty four Malaysian subjects age ranged between 18 to 25 years that were able to read Chinese text were chosen to participate in this study. The horizontal and vertical Chinese texts were arranged in paragraph form and were printed out on an A4 paper. Both texts were chosen from Andersen children's story books. The experiment was carried out on the subjects by using randomization to choose the first text orientation to be read. The subjects were asked to read aloud the Chinese text at 40cm for five minutes separately with a five minutes break in between the two texts. The total number of words read in five minutes was recorded and the reading speed was calculated in words per minutes (wpm). Paired t-test result showed there was a significant difference between the mean reading speed of horizontal and vertical aligned text ($p < 0.001$). The results showed that the mean reading speed for horizontal text ($257\text{wpm} \pm 72$) was significantly higher when compared to the mean reading speed of vertical text ($209\text{ wpm} \pm 49$). There was no significant difference among genders in reading the two texts. Thus, the study had found that reading in horizontally presented text tends to be faster than reading in vertical text in population.

Keywords: Reading speed, Text orientation, Chinese text

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Introduction

Text is traditionally presented in horizontal lines which are from left to right (Laarni et al. 2004). People or individuals who speak in English are prone to read horizontal text, but there are few conditions in which text is arranged vertically. For example, the title is printed vertically along the spine of a book in North America and Europe. In certain situations, because of small horizontal space, the text required to be presented vertically. For example, the vertically aligned “watch your step” signs that are stick on the poles besides the doors of buses. The road names are painted on pillars vertically in few cities such as Florida and California (Yu et al. 2010).

Vertical orientated texts are more often used in Asian languages such as Chinese, Korean and Japanese (Laarni et al. 2004). In Chinese text, there are few situations in which the arrangement of the text is in vertical form. In China, there are major publications still publish traditional text layout which is in vertical orientation (Chor 2007). In Taiwan, children’s text books use vertically written text (Wang 2015). The vertical style of writing is said to be a feature found in languages that use Chinese characters.

Text direction in which either the text is read horizontally or vertically has been found to affect reading rates (Chan & Ng 2012). The advantage of vertical text is the reader does not need to move the eyes horizontally during the text reading because the words are quite short. Besides, a shorter time is used to plan for saccadic eye movement if there is only single fixation on a line in vertical reading because one line saccades to the following line would be the same length (Laarni et al. 2004). The purpose of this study was to determine the effect of Chinese text orientation on reading speed.

Materials and Methods

A. Study Population

The selected subjects were aged between 18 to 25 years. Subjects with best corrected distance visual acuity of 6/6 or better, near visual acuity at least N8 at 40 cm, within normal range of horizontal and vertical vergence, within normal range accommodation and positive saccadic and pursuit eye movement were included. Subjects had at least six years of Chinese education and were able to read Chinese literature were included. Subjects with known speech problem, psychological problem, dyslexia, amblyopia and any form of ocular disease were excluded.

B. Screening Assessment

A screening procedure was carried out on the subjects to be included for this study. Subjects that fulfilled the requirement were given a consent form. A complete and detail history taking was carried out. The monocular and binocular habitual VA were measured using Snellen chart at 6 meter and near

reading chart at 40 cm. For further assessment of distance VA, pinhole had been used to determine whether the vision can be improved while +1.00 was carried out to check any overcorrection of power or any presence of latent hyperope. For stereoacuity, Stereofly test was used. The near point of accommodation (NPA) and the near point of convergence (NPC) were taken using the Royal Air Force (RAF) rule. To test for the saccadic eye movement, Northeastern State University College of Optometry (NSUCO) eye movement test was carried out. Phoria was measured using Maddox rod. Subjects were required to undergo Chinese reading test to determine their ability to read Chinese fluently.

C. Research Test

The experiment was conducted under room illumination of 180 ± 20 lux and subjects was required to sit straight with the viewing distance at 40cm and complete a reading task by read it aloud from the printing materials. Subjects were asked to read with their habitual correction. The two texts were in paragraph form and were chosen from Andersen children's story book. Subject was given two sets of text. In each set, it had one horizontal text and one vertical text as shown in Figure 1. They underwent randomisation to choose the text from the two sets. Time given for reading was five minutes and the time was calculated using iPhone 6S plus stopwatch. Number of letters read in five minutes was calculated among two sets of text and were recorded. Reading speed was measured by reading aloud the words with certain difficulty level within five minutes and it was calculated by the total of words read within one minute (words per minute) with the formula as shown in equation 1 (Alabdulkader and Leat, 2017),

The data collected was analysed using IBM SPSS Statistics Version 22 (New York, USA).

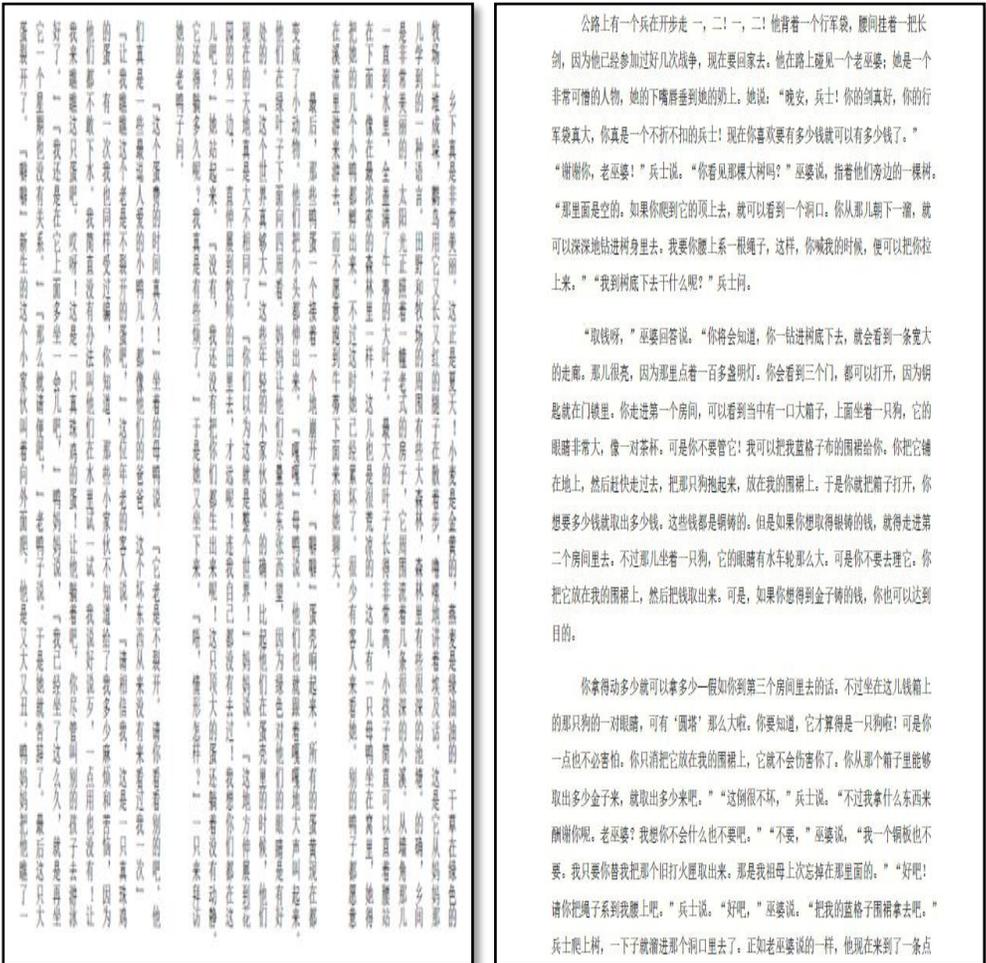


Figure 1 Horizontal and Vertical text direction reading material

Results

Thirty four subjects within age range of 18 to 25 years and mean age of 22.76 years \pm 1.10 were participated in this study. Out of the 34 subjects, 19 of them were female and 15 were male.

The mean reading speeds for horizontal and vertical text are shown in Figure 2. Paired t-test was used to compare the mean reading speed between horizontal and vertical reading. There was a significant difference between the mean reading speed between horizontal and vertical reading ($p < 0.001$), whereby the mean reading speed in horizontal reading ($257\text{wpm} \pm 72$) was higher compared to the mean reading speed in vertical reading ($209\text{wpm} \pm 49$).

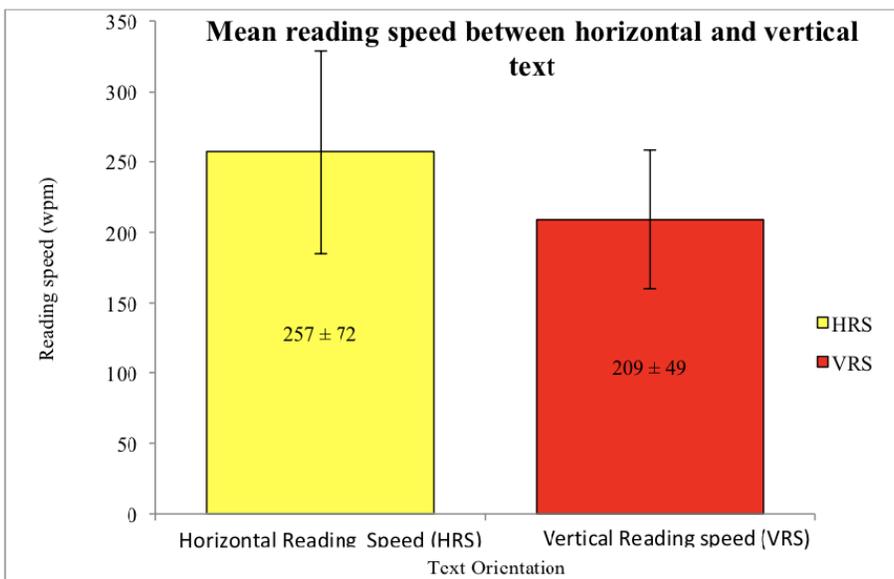


Figure 2 Reading speed between horizontal and vertical text direction.

There was no significantly difference between male and female in the mean reading speed of horizontal and vertical text direction, ($p > 0.05$). Figure 3 shows the mean reading speed in both texts among gender.

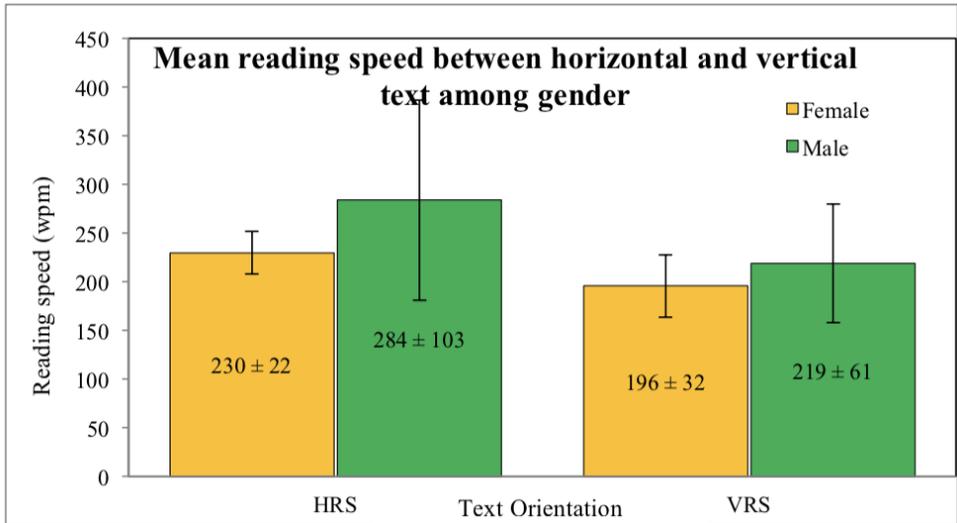


Figure 3 Reading speed between horizontal and vertical text among gender.

Discussion

This study investigated the reading performance of Chinese horizontal and vertical text orientations by comparing the reading speed between both orientations. The results showed that there was a significant difference in mean reading speed when reading in horizontal and vertical orientated text. Subjects read horizontal text faster compared to the vertical text.

Laarni et al. (2002) found that reading vertical text from a pocket computer seems to be slightly faster compared to reading horizontal text and vertical text gave a better text comprehension. This is or could be because no horizontal eye movements are needed to be made, readers reported that the reading were more easy with vertical text. Vertical text orientation is the suitable to be used on small narrow screens that only fit one to two letters on a single line (Laarni et al. 2004). Toet and Levi (1992) showed radial

direction had a stronger crowding effect than in the tangential direction, indicating that tangentially presented text may be more convenient to read than radially orientated text.

Laarni et al. (2004) investigated the effect of horizontal and vertical online magazine on a computer screen. They compared the reading speed in three conditions which are in horizontal standard text form, vertically one-word-per-line form and vertically hyphenated formats. The study showed that the participants tend to read vertical text slower than horizontal text from a computer screen but there were no differences in fixation number and regressions numbers between the two texts. They found that reading vertically on computer screen took longer time because readers need to move the page frequently and need to make eye movement more often from the bottom to the top of the page. There were also no differences in comprehension of text between both texts. This indicates that reading vertical text through a display may be same in terms of efficiency.

Legge et al. (2001) created a model which showed markedly reliable of reading speed on the visual span size. Legge et al. (1997) found that a decrease in size of visual span will lead to a decrease in mean saccade length. When the mean saccade length decreases, the reading speed will also decrease. Yu et al. (2010) compared reading speed of English horizontal and vertical text using two display types which are in rapid serial visual presentation (RSVP) words and flashcard which consists of a four line block of text. Three different formats of vertical text are used in their study which is in clockwise rotation, anticlockwise rotation, and marquee form. They concluded that vertical text has slower reading speeds because of its smaller

visual-span size. Horizontally aligned text has a larger perceptual span than in a vertically aligned text and readers have better control in eye movements when reading a horizontal text (Ojanpää et al. 2002).

According to Seo and Lee (2002), the main cause of slower reading speed in vertical reading was smaller gaze amplitude for vertical reading, and thus more frequent saccade and fixation for a given length of text. Increased gaze saccades velocity in horizontal reading also gives to a faster reading speed. Babkoff, Faust, and Lavidor (1997) found increased lexical-decision task performance when switching from vertical words to the horizontal words. The results showed readers had reduced lexical-decision accuracy and increased reaction time when reading vertical text. In Shih and Goonetilleke (1998) study, they showed that Chinese and horizontal menus written in Chinese had faster selection than the English written vertical menus. Horizontal menus had better performance regarding of search time and total time (Shih and Goonetilleke, 1998).

Byrne (2002) compared four different direction of English texts reading speed which are in horizontal, marquee, clockwise rotated and anti-clockwise rotated form and all letters used were three-syllable letters. They found that reading horizontal text is the fastest compared to the three vertical text presentations, followed by both rotated formats and the marquee presentation appear to be the slowest. They concluded that horizontal text is preferred when rapid word recognition is needed.

In Wang (2015) study, the subjects preferred horizontal and fully-spaced text. These two forms of texts are the fastest and the more understandable

when faced with difficult text. Chan and Ng (2012) compared the proof reading time between Chinese horizontal and vertical text among Hong Kong University City students. The results showed that horizontal aligned text has faster proofreading time than the vertical aligned text. They concluded that this might be because of the horizontal search pattern helps the reading and fixation process and the other reason is due to smaller visual span size of vertical text.

In present study, most of the subject reported that the vertically presented text is more difficult to read and more complicated compared to the horizontal text. This is because subjects had been using horizontal text all the time. The unfamiliarity with vertical text causes difficulty to plan and make up and down saccades through a vertical sentence and this causes a reduction in reading speed (Yu et al. 2010). Japanese readers who used to read with both horizontal and vertical reading showed that there was no significant difference between reading speed of horizontal and vertical text (Oda, Fujita, Mansfield, & Legge, 1999).

The orientation of Chinese characters also affects the reading speed. According to Zang et al., (2013), when reading left to right letters, readers were more likely to make refixations compared to when reading top to bottom words. This is because when reading left to right letter, they need to divide characters into horizontally adjacent radicals and as well as horizontally segmenting character strings into words. However, when reading from top to bottom character words, readers divide and determine radicals in the vertical dimension, and words in the horizontal dimension, which seems to be easier.

Current study also found no statistically significant difference among gender between the reading speed of horizontal and vertical text. However, considering the mean of reading speeds of male and female, it is clear that mean reading speed for male is faster compared to female which is in accordance to a study conducted by Emam, Youssef, and Riyadh (2012). They had found that there was a difference in reading speed among gender. Female make more frequently fixation compared to males and took more time in each part than males during reading. They concluded that females might spend more time to concentrate and understanding the content whereas males might read fast without understanding the text. However, there are other studies showed that females read faster than males. Roivainen (2011) found that females were better and faster in reading tasks that consist of alphabets, numbers and also they are good in rapid naming. According to Lynn and Mikk (2009), females had better performance in reading and writing ability compared to males. This is because females tend to involve more in language associated activities at home or in school. Females are more excellent in most reading activities, especially on explanatory and description of object than males (Rosén 2001). Current study showed male reads faster than female clinically which is same as the previous study but statistically it is not showing any significant difference. This could be due to small sample size as males are lesser than females and the male population present a greater standard deviation compared to female.

Further experiment can be performed by measuring the amplitude of accommodation and phoria before and after reading the horizontal and vertical text to see any difference in accommodation between both texts.

Score questionnaire can be given to the subjects to know about their condition after reading the two types of text.

Conclusion

The study found that the text orientation affects the reading speed. The horizontal text reading tends to be faster than vertical reading. Most of the subjects reported that vertical text is difficult to read and they need to focus more while reading. Therefore, reading material should be in horizontal orientation so that readers can read faster in study population.

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Reliability and Validity of Malay Version of Rapid Estimate of Adult Literacy in Dentistry (MREALD-30) among the Indigenous Malaysian Population

*Rath A., Hesarghatta P.R., Muttalib K.A., Sidhu P., Endicott K.,
Fernandes B., Halasagundi V*

Abstract

Objectives: To evaluate the reliability and validity of the Malay Rapid Estimate of Adult Literacy in Dentistry (MREALD-30) for the Orang Asli community of Malaysia. **Methods:** A convenience sample of 500 subjects were approached, of which 482 agreed to participate in giving a response rate of 96.4%. Rapid Estimate of Adult Literacy in Dentistry (REALD-99), was translated into Malay to prepare the longer and shorter versions of MREALD-99 and MREALD-30, piloted and revised by experts. Each participant was provided with MREALD-99 which also includes words from MREALD-30. Demographics, oral health status, oral health-related quality of life, and health literacy were analyzed. Summary measures, internal consistency, reliability, and convergent and predictive validity were calculated. **Results:** Cronbach's alpha was 0.876, the intra-class correlation coefficient was 0.789 for reliability, Pearson's and Spearman's correlations were ≥ 0.693 for convergent validity, and ≤ -0.138 for predictive validity. **Conclusions:** MREALD-30 showed excellent reliability, good convergent and concurrent validity to measure oral health literacy in the indigenous Malaysian population.

Keywords: REALD-30, Malay, Health Literacy, Dental, Word recognition instrument, Orang Asli

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Introduction

The twenty-first century requires an individual to possess sufficient health-related literacy skills so that one can understand and implement the knowledge or instructions provided by a healthcare worker. It is long been known that poor oral health and untreated oral conditions have a deleterious impact on systemic health and quality of life (UNESCO 2004). Preventable and treatable oral diseases remain widespread, particularly amongst poor and underserved populations (US Department of Health and Human Services 2000).

Indigenous communities in Malaysia and the current oral health statu

The Orang Asli are the indigenous people of Malaysia. In 2012, their population was approximately 178,197 or representing a mere 0.9% of 29.7 million people in Malaysia (NIH 2005). The significant challenges and issues faced by the indigenous people include financial, health, nutritional, and educational dimensions. The Orang Asli, with a few minor exceptions, are descendants of ancient inhabitants of the Malay Peninsula. They consist of at least nineteen culturally and linguistically distinct subgroups ranging in population from a few hundred (Kensiu, Kintaq, Menriq and Lanoh) to about 49,000 (Semai) (Masron T. 2013). Three major tribes of Orang Asli are present in Peninsular Malaysia. These tribes include; Negrito, Senoi, and Proto-Malay (Othman CN 2012). The Orang Asli Proto-Malay are the second largest tribe with ~75,000 people divided into six sub-tribes (Kanaq, Kuala, Seletar, Jakun, Semelai and Temuan) (Yu C. et al. 2016). The Malaysian government has relocated most of the Orang Asli to the periphery

of towns with primary education and healthcare facilities (Thevakumar K. et al. 2016).

Oral Health Literacy and its related measuring instruments

Although recently gaining more attention, there has been little work in the field of oral health literacy (OHL) or, more specifically, the impact of oral health literacy on oral health outcomes, amongst disadvantaged groups such as the Orang Asli community. Health literacy has been defined as “the degree to which individuals can obtain, process and understand the basic health information and services they need to make appropriate health decisions” (Seldon CR et al. 2000).

In the oral health context, literacy can be considered as the skills necessary for people to understand the causes of poor oral health, to learn and adopt fundamental aspects of positive oral self-care behaviors, to communicate with oral health care providers, to understand the importance of the treatment provided and comply with them, including follow-up appointments and compliance with prescribed medication (Sharma G. et al. 2014). This definition addresses functional oral health literacy, encompassing knowledge as well as ability to use that knowledge in making appropriate oral health-related decisions. Oral health literacy (OHL), in this definition, encompasses far more than reading; it involves writing, numeracy, speaking, listening and ‘understanding the system’ (Jackson RD. et al. 2008). Evidence says that there is a positive association between OHL and the oral health status (Rudd R 2003).

Due to the complexity of both verbal and written oral health communications, there forms a significant barrier to improve oral health (NIH 2005) and that OHL is inevitable to promote oral health and to prevent oral disease (U.S. Department of Health and Human Services 2010).

Word recognition tests have demonstrated a strong correlation with the general reading ability and reading comprehension (Davis TC 2006), with evidence suggesting that if a person has difficulty in pronouncing dental-related words, then that person may additionally have difficulty with comprehension; a higher order skill (Gong D 2007).

The Rapid Estimate of Adult Literacy in Dentistry (REALD-99/30) was developed as there was no method available to assess dental literacy in adults (Richman JA et al. 2007, Lee JY et al. 2007).

At first, this instrument was developed as REALD-30 by Lee et al. and it consisted of thirty commonly used dental terminologies. Later another sixty-nine words were added only to cover a wide range of terminologies. The words were placed in increasing order of difficulty, and the overall score was obtained giving one point for each word pronounced correctly and summing it all up. The reliability and validity of this tool showed its effectiveness in measuring the dental health literacy among adults (Wong HM et al. 2012, Aruna Devi M et al. 2011). It is simple and easy to administer when compared to other oral health literacy instruments.

Currently apart from REALD, the other dental literacy instruments available are Test of Functional Health Literacy in Dentistry (TOFHLiD) (Gong DA 2007), Oral Health Literacy Instrument (OHLI) (Sabbahi DA 2009),

Comprehensive Measure of Oral Health Knowledge (CMOHK) (Macek MD et al. 2010) and the brief 20-item dental/medical health literacy screen (REALMD-20) (Gironda M et al. 2013).

No matter who portrayed favourable characteristics of these instruments in determining the literacy levels are limited to specific populations. For researchers to identify the literacy levels of these population, it is practically necessary to develop an instrument in their native language which will help in implementing strategies to improve the level of understanding of the patients and their communication with the healthcare personnel.

The objective of this study was to translate, perform the cross-cultural adaptation of the Rapid Estimate of Adult Literacy in Dentistry to Malay language (MREAL-30) and test the reliability and validity of this version among Temuan tribe in Orang Asli community in Malaysia.

Methodology

Study population

The target population for the present study constituted the Temuan tribe (subtribe of Orang Asli) of Kampung Tering, located in Johor, Negeri Sembilan, Malaysia. Ethical approval was obtained from the Ethics committee of Health Sciences, SEGi University, Malaysia. A Free Prior Informed and written consent were obtained from the village head of the community before proceeding with the study. All the participants gave written informed consent before participating. Participants with limited reading ability had consent forms read to them. A convenient sample of 500

subjects who fulfilled the inclusion criteria (aged over 18 years) was invited to participate, of which 482 of them provided the consent for the assessment of validity. The participants were inquired about the difficulties in understanding the items and changes were made accordingly. A random selection of 30 participants was recalled after two weeks for reliability assessment.

Instruments used

Translation and expert revision of the REALD

A pool of "dentistry related words" was constructed by translating English REALD-99 [6] words into Malay. World Health Organization (WHO) guidelines for the translation and adaptation of instruments were followed (http://www.who.int/substance_abuse/research_tools/translation/).

An expert panel was convened with two bilingual dental professionals to resolve the discrepancies between the independently translated versions. Also, an independent professional translator back-translated the Malay version into English, and no discrepancies existed between the original and back-translated English versions of MREALD-99. The translator was instructed to aim at the conceptual equivalence of the words but not the literal translation.

Two bilingual interviewers conducted structured interviews. Each participant was provided with the MREALD-99 and was asked to read them aloud. Each immediate correct pronunciation for the word received one mark, while pauses, hesitations, and repetitions received a 0 mark. The total

score for MREALD-99 thus ranged from 0 to 99 (higher total score suggests a higher dental literacy level). Other background characteristics recorded for the records were socio-behavioural information like age, gender, education level.

Variables and data collection

Variables were arranged in five groups:

- Demographics: gender, age, education level.
- Oral health literacy: measured using the REALD-30 and REALD-99.
- Oral health: oral hygiene (Oral Hygiene Index Simplified, OHIS), periodontal disease (Community Periodontal Index, CPI), and caries history (DFMT).
- Oral health-related quality of life (OHRQoL): using the Oral Health Impact Profile of 14 items validated in the Malaysian Population (OHIP-14M) (Saub R et al. 2007).
- Psychometric properties: internal consistency, reliability, convergent validity (correlation with MREALD-99) and predictive validity (correlations with the CPI, OHIS, DFMT, and OHIP-14).

Statistical analysis

Summary measures for all variables were calculated. Internal consistency was evaluated using Cronbach's alpha coefficient. MREALD-30 was expected to be internally consistent if it acquired a coefficient of at least 0.70 (Nunnally JC and Bernstein IR 1994). To assess the reliability of MREALD-

30 across times, a test-retest reliability analysis was carried out, and the intra-class correlation coefficients (ICC) were computed (ICC agreements; <0.40-poor to fair, 0.41-0.60-moderate, 0.61-0.80-good, >0.80-excellent) (Bartko JJ 1966), and Lin concordance correlation coefficient (LCCC) were estimated for reliability. Pearson's r and Spearman's ρ correlation coefficients were estimated for predictive validity ($p < 0.05$). For convergent validity, Spearman correlations were calculated between MREALD-30 and MREALD-99. The distribution of the MREALD-30 across different educational levels was tested to explore the discriminant validity and confirm differences, through a nonparametric test (Kruskal-Wallis). STATA/SE 13 (Stata Corp., USA) and SPSS 21 (IBM SPSS, USA) were used for the analysis.

Results

Four-hundred eighty-two patients participated in the study. Approximately, one third (32.8%) of the study population had never been to a dentist. There were significant differences in MREALD-30 across categories of educational levels of the subjects ($p=0.02$). Higher scores on the MREALD-30 were seen in adults with higher educational status (Table 1).

Table 1. Background Characterization of the participants

Variable	Male (n=138), Female (n=344) (n %)	MREALD-30 Mean (SD)	MREALD-99 Mean (SD)
Educational status			
Primary	6.2	15.5(10.1)	55.2 (34.2)
Intermediate	5.1	19.3 (7.3)	69.7 (21.6)
Secondary	3.4	21.5 (4.8)	72.9(15.9)
Dental visit			
Visited within previous 6 months	26	22.6 (5.7)	76.5 (16.1)
Visited within previous 6 -12 months	41.2	22.8 (6.6)	78.5 (18.1)
Never been to a dentist	32.8	20.2 (7.6)	69.0 (24.5)

The DFMT average was 13.4 ± 6.6 . The CPI codes distribution was: 2.7% were 0, 19.0% were 1, 46.4% were 2, 25.5% were 3, and 6.3% were 4. The average OHIS was 0.71 ± 0.76 . The average OHIP-14M was 17.3 ± 11.3 . The internal consistency of both the Malay word recognition instruments was good, Cronbach's alpha was 0.876 and 0.91 for MREALD-30 and MREALD-99 respectively. ICC reliability was 0.789 (CI 95% 0.546-0.910), and LCCC reliability was 0.788, 30 participants assisted to the retest. MREALD-30 correlated significantly and positively with the other oral health literacy tool, MREALD-99. Convergent and predictive validity is shown in Table 2.

Table 2. The validity of the rapid estimate of adult literacy in dentistry for the Orang Asli community.

Psychometric property	Pearson's r and Spearman's rho	p-value
Convergent validity MREALD-99	r = 0.719; rho = 0.693	<0.01
Predictive validity		
CPI	r = -0.250; rho = -0.252	
OHIS	r = -0.138; rho = -0,141	

DFMT	r = -0.279; rho=-0.270	<0.01
OHIP-14M	r = -0.171; rho = -0.170	

Discussion

Oral health being part of general health also requires sufficient attention concerning measuring and improving the dental literacy skills of the community. To our best of knowledge, this is the first study that has attempted to introduce and evaluate the psychometric properties of an oral health literacy instrument for Malaysian indigenous population. MREALD-30 demonstrated excellent internal consistency and reliability on repeated administrations. It was also significantly related to MREALD-99, OHRQoL and educational status, therefore exhibited good convergent and concurrent validity.

Oral health literacy may be a determinant of oral health (Tadakamadla et al. 2014). Therefore, there is a need to identify individuals with low oral health literacy in every population which requires appropriate oral health literacy instruments.

Although word recognition instruments are not comprehensive and ideal, they are instruments of choice in community settings for their ease of administration and less time consuming. Widely used word recognition instruments in the field of dental health literacy are REALD-30 and REALD-99 (Eleanor JP 2010). Although both the tools have good internal reliability and construct validity, we have preferred REALD-30 for Malay adaptation over REALD-99 as it is less time consuming and causes less burden to the respondent. The proponents of REALD have also

recommended the use of REALD-30. As there are no validated word recognition instruments in Malay, we have also translated REALD-99 into Malay only to evaluate the convergent validity of MREALD-30.

The internal consistency expressed as Cronbach's alpha of both MREALD-30 and MREALD-99 was found to be excellent and consistent with those from previous studies (Richman JA et al. 2007, Lee JY et al. 2007) and Hong Kong Rapid Estimate of Adult Literacy in Dentistry (HKREALD-30) (Wong HM et al. 2012). For evaluating temporal stability, we have also assessed the test-retest reliability which was found to be excellent for both MREALD-30 and MREALD-99. MREALD-30 exhibited good convergent validity and had an excellent correlation with mREALD-99. The current study demonstrated that the REALD-30 has adequate psychometric properties similar to previous validation studies of other OHL instruments (Dickson-Swift V 2014, Lee JY 2007)). In terms of reliability, the ICC values of the REALD-30 was almost the same as that of the OHIP-14M. The ICC and LCCC reliabilities were very similar to previous studies (Lee JY 2007), showing a high correlation with the REALD-99. The predictive validity was evaluated by the relationship between oral health outcomes due to adequate evidence about the influence of OHL in the prevalence and severity of oral diseases (Chidzonga MM 2015). MREALD-30 exhibited good concurrent validity with better literacy scores being reported by subjects with higher educational attainment and vice-versa.

Several criticisms have arisen recently about recognition pronunciation instruments; critics have been encouraging the Development and use of comprehension instruments (Dickson-Swift V 2014). The REALD-30 has

clear advantages over these instruments because it is more straightforward, quicker, cheaper, and appropriate for clinical use (Lee JY 2007). However, the REALD-30 tests recognition, a very complicated process in which vocabulary knowledge is associated with better recognition performance (Whiting C et al. 2015, Yap MJ 2012). This implies that the REALD-30 is a recognition instrument, not a reading one. Validating this instrument into Malay language makes this the first OHL instrument available for the indigenous population of Malaysia. In future researches must focus on evaluating the OHL in Malay-speaking populations and assess interventions aimed to improve OHL levels and oral health status.

Conclusions

The MREALD-30 showed excellent reliability on repeated administrations and demonstrated very good internal consistency. Each of the items demonstrated to have a good fit to the data, and the subjects of concern were demonstrated to fit the model. However, further studies on different sub-communities of Orang Asli selected from a diverse population are recommended to assess the generalizability of MREALD-30. It would also be interesting to see the responsiveness and sensitivity of the instrument to change across time and the communities.

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Conflicts of Interest: None

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