

True and False Relationship of Impacted Mandibular Third Molar with Inferior Alveolar Canal: A Retrospective Study

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ABSTRACT

Background: Knowledge of the radiographic relationship of impacted mandibular third molar with inferior alveolar canal is important for assessing the risk during its surgical removal. The aim of this study was to compare the right and left side true and false relationship and distance of impacted mandibular third molar roots with inferior alveolar canal.

Materials and methods: 350 panoramic radiographs (194 male and 156 females; 20-60 years) were evaluated with total of 585 impaction of mandibular third molar. Impactions were categorized in to left and right side and the radiographs were interpreted for gender predominance, age groups predominance, radiographic distance between impacted mandibular third molars to inferior alveolar canal and presence of one or more of the eleven radiographic true and false relationships of impacted mandibular third molar roots with inferior alveolar canal.

Results: The data tabulated was subjected to Chi-square test for statistical analysis. The gender distribution among various age group was statistically significant with its p value 0.04 and the association between age group and side of distribution was statistically significant with its p value 0.021 and 0.015 for unilateral and bilateral impaction. The overall mean distance from the impacted mandibular third molars to inferior alveolar canal was -0.7445mm. Most of the samples extended beyond the superior border of the inferior alveolar canal. Inverted impactions were found to be in the close proximity (-4.47 mm) to inferior alveolar canal than any other type. For true relationship interruption of white line and in the interruption of white line, vertical impactions were the most common impactions. For false relationship adjacent and in the adjacent category, vertical impactions were the most common impactions. Interruption of the white line was most common true relation on right and left side and Adjacent was most common false relation on right and left side.

Conclusion: It can be concluded that panoramic radiographs are reliable in assessing the proximity of impacted mandibular third molars to inferior alveolar canal. Inverted and vertical impactions are more closely placed to inferior alveolar canal and interruption of the white line is the most common true relationship on the panoramic radiographs.

Keywords: Panoramic radiographs, Inferior alveolar canal, Impacted mandibular third molars, True and false relationship.

INTRODUCTION

Mandibular 3rd molar erupts at the age of 17-21 years of age with root completion between the ages

of 18-25 years. Some mandibular third molar remains partially or completely impacted within the

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bone, which is mainly due to tooth material-arch length discrepancy. According to Archer (1975) "The tooth that fails to erupt in oral cavity in its functional position and which has lost its further potential to erupt is called as impacted tooth" Mandibular third molars are the most frequent impacted teeth (approximately 40%) and are associated with various pathoses ranging from infection, inflammatory to cystic lesions necessitating their surgical removal. Neurosensory disturbances related to the inferior alveolar nerve due to the close anatomic relationship between the roots of mandibular third molars and the inferior alveolar canal is one of the most grave complications of such a procedure.^{1,2} This makes assessment of proximity of mandibular 3rd molar with inferior alveolar nerve canal essential. To prevent any complication following 3rd molar surgery and to have a proper treatment planning, an optimum diagnostic aid is needed. Owing to the benefit of availability, less chances of infection spread, higher patient's compliance, less radiation exposure, more diagnostic property, and being more economic, Panoramic Radiography is employed in following study as diagnostic aid for determining proximity between impacted 3rd molar and inferior alveolar nerve.³ Cone Beam Computed Tomography (CBCT), Denta Scan, computed tomography are some other diagnostic modalities also available to locate inferior alveolar nerve and canal, but availability in small towns and cost factor also play an important role to make a choice. In modern dental practice both digital and manual panoramic radiograph machines are easily available even in small towns. Apart from conventional intra oral periapical radiographs, orthopantomogram gives better view to the operator for accessing additional features like mandibular height, relation Dentistry Section between second and third molar, and better view of density of bone. There are many radiological variables seen on orthopantomogram to assess the proximity of inferior alveolar nerve to the roots of third molars but among all findings these seven radiological variables described by research workers are of important value . 1. Darkening of roots where it crosses inferior alveolar canal. 2. Deflected or hooked roots around inferior alveolar canal. 3. Narrowing of roots due to grooving by the nerve. 4. Interruption or obliteration of either of white cortical lines of inferior alveolar canal. 5. Bifid root apex

representing intimacy of the apical periodontal membrane. 6. Diversion or bending of root canal in the region of root apices. 7. Narrowing of inferior alveolar canal. Of these seven radiographic findings Rood and Nooraldeen Shehab identified three radiological variables (no.1, no.4 and no.6) significantly associated with inferior nerve injury. In a similar study Michel Sedaghatfar, Meredith A. August found that four radiological variables (no.1, no.3, no.4, no.6) are important variable to predict injury to IAN while removing third molar . Thus, this study was aimed to evaluate more deeply the association between impacted lower third molar and inferior alveolar canal based on radiographic signals suggesting proximity of structures.^{4,5}

MATERIALS AND METHODS

This retrospective study included 1000 panoramic radiographs out of which 350 radiographs (OPG) with impacted mandibular third molar teeth of patients of either sex between the ages of 20-60 years (divided in four groups 20-30,31-40,41-50 & 51-60), who in past visited to the department of oral medicine and radiology of Divya Jyoti College of Dental Sciences and Research. All images were taken with single digital care stream 8000 (Kodak c OPG machine). 73 KVP, 10 MA, 13.9 S with an exposure of radiographic modality in patients who came with other dental complain with total time duration from July 2019 to January 2020. The Inclusion Criteria were (1) Individuals presenting with unilateral or bilateral impacted mandibular third molars, (2) Adult Individuals between 20-60 years with impacted mandibular third molar and (3) Good quality radiographs. The Exclusion Criteria were (1) History of trauma or surgery to the mandible, (2) Developmental anomalies affecting the jaw, (3) Clinical and/or radiographic evidences of pathologies of the impacted mandibular third molar teeth or mandible (such as cyst or tumor) which could obscure the visualization of the periapical region or inferior alveolar canal., (4) Absence of second mandibular molar and (5) Inability to accurately identify inferior alveolar nerve canal on radiograph.

From each patient file, the demographics such as name, gender and age were recorded. Close relationship between impacted mandibular third molars and IAN canal was evaluated on OPG. Radiographs were then interpreted cautiously for

the following: (a) Radiographic distance between impacted mandibular third molars and inferior alveolar canal. The distance in millimeters between the inferior most part of the tooth and the superior border of the inferior alveolar canal was measured using OPG software. In instances where the inferior most part of the tooth was below the superior border of inferior alveolar canal a 'negative numerical' value was designated and vice versa. (b) According Root and Shehab classification ⁶(True relationship) and its Subdivision Hazza'a AM ⁷ (False Relationship) system the relationship of mandibular third molar and inferior alveolar nerve is determined by presence of eight signs like darkening of root, interruption of white line, diversion of canal, deflection of the root, narrowing of root, narrowing of canal, presence of dark and bifid root apex (true relations) and three signs like superimposition of root apex on canal, root apex being adjacent to the nerve canal and presence of developing root with its abnormal position in the jaw(false relations).

RESULTS

In the present retrospective study, a total of 350 OPG were taken, in which 585 impacted mandibular third molar (right & left side) were evaluated. Spss 22.0 version software was used for statistical analysis. There were 194 (55.4% males) and 156 (44.6% females) with age ranging from 20-60 years. Majority of subjects were in age group of 20-30years(142 cases, 40.5%) and 31-40years(112 cases, 32%) respectively. The mean age of the total male subjects was 34.18 (SD±10.12) years and the mean age of total female subjects was 32.02 (SD ±9.81) years. The gender distribution among various age group is statistically significant i.e. p value is 0.04 (p<0.001). In Chi Square test, the value was 13.304, Likelihood ratio was 14.006 and degree of freedom was 3.

In order to decide side predilection, statistics to find relation between gender and their side distribution of impaction was done. With the study it was evident that number of impaction were slightly more on left side (300 i.e. 51.3%) than on right side (285 i.e. 48.7%). There were 115 (33%) unilateral impaction (65 left side and 50 right side) and 470 (67%) bilateral impaction. Among them, males had 25 (13.4%) right unilateral, 37 (19.1%) left unilateral and 262 (67.5%) bilateral impaction and

Females had 25 (16%) right unilateral impaction, 28 (17.9%) left unilateral impaction and 208 (66.1%) bilateral impaction. Among the age groups, maximum impaction were in group 20 -30 years 246 (42%) followed by 31 -40 years 189 (32.3%). Among the association between age group and side of distribution the Pearson chi-square test value was 14.65 and the p- value 0.021 (<0.05) for unilateral and 0.015 (<0.05) bilateral impaction was statistically significant.

The radiographic distance from the apex of the impacted teeth to the inferior alveolar canal were measured in millimeters (mm) and divided into 20 groups. The impaction among these group was highest i.e. 192 (43.17%) in (-1.1) to (0.09) group followed by 106 (14.85%) in (-2.1) to (-1.09) group. The overall mean distance from the impacted mandibular third molars to inferior alveolar canal was -0.7445 mm(SD 2.1697). The mean distance from the impacted mandibular third molars to inferior alveolar canal on right was -0.8014 mm(SD 2.1990)and on left side was -0.6876 (SD 2.1417) . According to Gender, the highest number of cases belong to (-1.1) to 0.09 range having 73(44.6%) male cases and 26 (26.7%) females in right side and 49 male cases and 44 female cases in left side. The p- value were 0.297 and 0.393 for right and left side respectively showing statistical non-significant relation between gender and radiographic distance. According to Age, the highest number of cases belongs to (-1.1) to 0.09 range of distance between the apex and IAC, having 43(36.8%) cases in 20-30 years, 33(40.1%) cases in 31-40 years, 15(19.8%) cases in 41-50 years and 8(19.4%) cases in 51-60 years age group in right side and 44 (41.3%) cases in 20-30 years, 35 (30.2%) cases in 31-40 years, 12 (11.5%) in 41- 50 years on left side and 51- 60 years have more cases 7(20.6%) in 0.1 to 1.09 range group. The p- value is 0.000 for right side age group showing statistical significance between age group and radiographic distance between root apex and IAC. While the left side p-value is 0.537, which is non-significant.

According to Rood and Shehab (True relationship)⁶ & Subdivision Hazza'a AM⁷ (False relationship) classification criteria of impaction considered in this study the maximum number of involvement was interruption of white line 133(18.7%)in true relation and adjacent 154 (21.75%) in false relation.

The relationship between inferior alveolar canal and angular position of the mandibular third molar:- On right side relationships are found to be more common in vertical impaction i.e. 165(44.3%) cases, having mean value of 13(SD±3.32) and the least relationships are recorded in buccoangular impaction having 1 (0.6%) cases. For true relationship interruption of white line (62 cases) and in the interruption of white line, vertical impactions (34 cases), are the most common impactions. For false relationship adjacent (67 cases) and in the adjacent category, vertical impaction (40 cases), are the most common impactions. The P-Value is 0.013 for interruption of white line, 0.001 for darkening of root, 0.000 for diversion of canal and 0.022 for narrowing of canal. These are statistically significant so, there is an association between interruption of white line, darkening of root, diversion of canal and narrowing of canal to the angular position of impacted teeth.. Among false relationship, the P-Value is 0.000 for adjacent and none, 0.007 for superimposition, which shows statistical significance. On left side relationships are found to be more common in vertical impaction i.e. 167(44.3%) cases, having mean value of 9.12(SD±1.003) and the least cases were recorded in inverted impaction having 3 (1.1%) cases having mean value of 0.27 (SD±3.09). For true relationship interruption of white line (69 cases) and in interruption of white line vertical impactions (40 cases), are the most common impactions. For false relationship adjacent (85 cases) and in the adjacent category, vertical impaction (47 cases), are the most common impactions. Among true relationship, The P-Value is 0.001 for interruption of white line, which is less than 0.05 so is a statistical significance between these two. Among false relationship, the P-Value is 0.000 for adjacent and superimposition, which shows statistical significance relationships are found to be more.

Relation of classification with Gender and Age:- On right side the relationship between true and false relationship to gender shows more relationship in male having 175 cases (55.4%) than female having 130 cases (44.6%). The interruption of white line is more when comparing all relationship having 32 (16.5%) cases in male and 32 (20.5%) cases in female. The least relationship is developing root 2(1.0%) cases for male and narrowing of root

1(0.6%) case for female. The p-value is 0.045 for deflection of roots and 0.031 for adjacent showing statistical significance among genders in these two relations. According to age the highest relationship is interruption of white line 32(22.5%) cases among 20-30 years, adjacent 22(19.6%) cases among 31-40 years, adjacent 14(23%) cases among 41-50 years and adjacent 11(32.4%) cases among 51-60 years. The least relationship is diversion of IAC and Deflection of root 10 (7%) cases among 20-30 years, Deflection of root 2 (1.8%) cases among 31-40 years, diversion of IAC 1(1.6%) case among 41-50 years and Deflection of root 1(2.9%) case among 51-60 years. The p-value is 0.000 for narrowing of root and 0.109 for adjacent showing statistical significance among age group in these two relations. Other true and false relationship has p-value more than 0.05 showing non-significant relationship. On left side the relationship between true and false relationship to gender shows more relationship in male having 194 cases (55.4%) and female having 156 cases (44.6%). The interruption of white line is more when comparing all relationship having 41 (21.1) cases in male and 28 (17.9%) cases in female. The least relationship is developing root 1(0.5%) case for male and diversion of IAC, deflection of root 5(3.2%) cases for female. The p-value is 0.016 for developing root showing statistical significance among gender. So there is association between developing root to gender. . The highest relationship is interruption of white line 34(23.9%) cases among 20-30 years, adjacent 30(26.8%) cases among 31-40 years, adjacent 14(23.0%) cases among 41-50 years and adjacent 11(32.4%) cases among 51-60 years. The least relationship is Deflection of root 3 (2.1%) cases among 20-30 years, narrowing of root 1(0.9%) cases among 31-40 years, Deflection of root 1(1.6%) cases among 41-50 years and narrowing of root 1(2.9%) cases among 51-60 years. The p-value is 0.008 for developing root showing statistical significance among age group. Other true and false relationship has p-value more than 0.05 showing non-significant.

DISCUSSION

The word impaction is from Latin origin—*impactus*. Impaction is cessation of eruption of a tooth caused by a physical barrier or ectopic positioning of a tooth and will not eventually assume a normal arch relationship with the other teeth and tissues.⁵ Accurate assessment of the position of the inferior

alveolar nerve in relation to the impacted third molar might reduce injuries to this nerve. Various preoperative radiographic techniques to evaluate the relation between the mandibular third molar and the inferior alveolar canal have been used. These include intraoral periapical radiographs, occlusal radiographs, panoramic radiographs, cross sectional tomograms, scanography and computed tomography. However, the panoramic radiography has been recommended as the primary radiographic investigation of choice in pre-operative assessment of mandibular third molar teeth and their surrounding structures.⁶

According to the data obtained from statistical analysis, the mean age of impaction in the present study was detected to be 34.18 (SD±10.12) years in males and 32.02 (SD±9.81) years in females. The gender distribution among various age group is statistically significant i.e. p value is 0.04 (p<0.001). In Chi Square test, the value is 13.304, Likelihood ratio is 14.006 and degree of freedom is 3 with maximum cases were recorded with the age group of 20-30 years followed by 31-40 years. A study by Chaurasia et al⁸ also showed highest incidence of impacted third molar (600 in their 1000 randomly selected samples) in similar kind of age group (18-30 years). Study of Saad SS et al⁵ also showed maximum number of subjects in the 21-25 year age group (66 in 100 subjects). Deshpande P et al² also found male predominance (65.6% over females 34.4%). Gupta S et al¹ also found 53.11% males over 46.89% females. However, study of Tassoker M et al⁹ and Leung y¹⁰ showed female predominance (61% over male 39%) and (72.9% over male 27.1%) respectively.

In the present study, maximum number of bilateral impactions (470 i.e. 66.8%) were noted, followed by 115 (33%) unilateral impaction (65 left side and 50 right side) and 470 (67%) bilateral impaction. Among this, males have 25 (13.4%) right unilateral, 37 (19.1%) left unilateral and 262 (67.5%) bilateral impaction. Females have 25 (16%) right unilateral impaction, 28 (17.9%) left unilateral impaction and 208 (66.1%) bilateral impaction. According to age group, maximum impaction are in group 20 -30 years 246 (42%) followed 31 -40 years 189 (32.3%). The Pearson chi-square test value is 14.65 and the p- value is 0.021 and 0.015 for unilateral and bilateral impaction respectively which shows there is an association between age group and side

of distribution is statistically significant. The present study was in accordance with Hazza'a AM et al⁷, who found bilateral impaction (1167 i.e. 85.9%), followed by unilateral left side impaction (114 i.e. 8.4%) and unilateral left side impaction (78 i.e. 5.7%).

In the present study According to Rood and Shehab (True relationship) & Subdivision Hazza'a AM (False relationship) the maximum number of involvement in relation is Adjacent 154 (21.75%) followed by interruption of white line 133(18.7%) , superimposition 113 (15.8%), darkening of root 79 (12.1%), narrowing of IAC 54 (9.45%), none 45 (7.3%), diversion of IAC 28 (5.2%), deflection of root 27 (5.1%), developing root 15 (3.2%), narrowing of root 9 (1.4%) and least dark & bifid root apex 0. In True relation the maximum number of involvement is Interruption of white line 133(18.7%). In false relation the maximum number of involvement in is Adjacent 154 (21.75%)

The present study showed relationship of inferior alveolar canal with impacted third molars having greater number of involvement in males. Out of (358 i.e. 54.49%) relationship in males, the maximum involvement was found interruption of white line (73 i.e. 20.3%) and least number of involvement was the bifid apex (0 i.e. 0.0%) in true relation and in false relation maximum involvement was found in Adjacent (94 i.e. 26.25%) and least number of involvement was None (26 i.e. 7.2%). In females, out of total (299 i.e. 45.5%) relationship, the greater number of involvement was interruption of white line, (60 i.e. 20.06%) and least number of involvement was bifid apex, (0 i.e. 0.0%) in true relation and in false relation maximum involvement was found in Adjacent (60 i.e. 20.06%) and least number of involvement was None (19 i.e. 6.3%).

Patients in the age group of 20-30 years had the greatest number of involvement with inferior alveolar canal (279 i.e. 42.46%). Most of the involvement was interruption of white line i.e. 66 cases and least number was bifid apex i.e. 0 case. Patient in the age group of 51-60 years had least number of involvement i.e. 60 cases (9.13%). Ranjan V et al¹¹ also showed same result with maximum relation of third molars in true relation was interruption of white line (38 i.e. 25.33%), followed by diversion of canal (22 i.e. 14.66%) and

darkening of root (13 i.e. 8.66%) and in false relation maximum relation of third molars was Adjacent (23 i.e. 15.33%). So when we compared the present study with different authors study then the relationship of inferior alveolar canal with impacted third molar was found to be different. As in present study, the adjacent was found maximum but in other studies superimposition and interruption of white line was recorded maximum. In this study samples the relationship between inferior alveolar canal and angular position of the mandibular third molar are further divided in right and left side. On right side the relationship between inferior alveolar canal and angular position of the mandibular third molar was found to be more common in vertical impaction i.e. 165(44.3%) cases, having mean value of 13(SD±3.32) followed by mesioangular having 96(22%) cases with mean value 10(SD±2.32), followed by horizontal impactions of 40 (10.3%) cases having mean value of 18(SD±3.87) and the least cases were recorded in buccoangular impaction having 1 (0.6%) cases. When comparing for true relationship between the angular position of impacted third molar right side with inferior alveolar canal. then 62 cases(18.3%) showed interruption of white line followed by darkening of root having 44 (12.6%) cases, then narrowing of canal i.e. in 9.7% (34 cases), then diversion of canal i.e. in 5.7%(19 cases), then deflection of root i.e. in 5.1%(18 cases), then developing root i.e. 2%(7 cases), then narrowing of root i.e. 1.4%(5 cases).When comparing for false relationship between the angular position of impacted third molar right side with inferior alveolar canal, then greater number of involvement was adjacent relationship i.e. 67 (19.4%), followed by superimposition i.e. 42 (12.9%) cases and lastly category none i.e. 22(6.3%) cases, out of total 320 cases.

On left side the relationship between inferior alveolar canal and angular position of the mandibular third molar left side was found to be more common in vertical impaction i.e. 167(44.3%)cases, having mean value of 9.12(SD±1.003) followed by mesioangular having 110(26.9%) cases with mean value 2.34(SD±4.302), followed by horizontal impactions of 41 (11.4%) cases having mean value of 8.25 (SD±0.321) and the least cases were recorded in inverted impaction having 3 (1.1%) cases having mean value of 0.27

(SD±3.09). When comparing for true relationship between the angular position of impacted third molar left side with inferior alveolar canal. then 69 cases(19.7%) showed interruption of white line followed by darkening of root having 35 (10%) cases, then narrowing of canal i.e. in 5.7% (19 cases), then deflection of root i.e. in 2.6%(9 cases),then developing root i.e. 2.3%(8 cases), then diversion of canal i.e. in 2.3%(8 cases), , then narrowing of root i.e. 1.1%(5 cases). When comparing for false relationship between the angular position of impacted third molar right side with inferior alveolar canal, then greater number of involvement was adjacent relationship i.e. 85 (24.6%), followed by superimposition i.e. 68 (19.4%) cases and lastly category none i.e. 22(6.6%) cases, out of total 328 cases. Similar results were observed by ranjan V et al¹¹ studied, angle wise distribution of inferior alveolar canal relation showing maximum mesioangularly placed third molars with interruption of white line relations (19 i.e. 12.66%), followed by horizontally placed third molar with Adjacent relations (17 i.e. 11.33%), then horizontally placed third molar with interruption of white line relations (14 i.e. 9.33%) .

CONCLUSION

It can be concluded that panoramic radiographs are reliable in assessing the proximity of impacted mandibular third molars to inferior alveolar canal. Inverted and vertical impactions are more closely placed to inferior alveolar canal and interruption of the white line is the most common true relationship on the panoramic radiographs.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Gupta S, Bhowate R, Nigam N, Saxena S. Evaluation of Impacted Mandibular Third Molars by Panoramic Radiography. International Scholarly Research Network Dentistry; Volume 2011, Article ID 406714, 8 pages doi:10.5402/2011/40671
2. Deshpande P, Guledgud M, Patil K . Proximity of Impacted Mandibular Third Molars to the Inferior Alveolar Canal and Its Radiographic Predictors: A Panoramic Radiographic Study.

- Journal of Maxillofacial Oral Surgery 2013; Volume 12(2):145-15
3. Impacted mandibular third molar tooth was more in **males** (194, 55.5%) than females (156, 46.4%). In age groups 20-30(females 43.6% & males 38.3%) and 31-40(females 37.8% & males 27.5%) females have more impacted mandibular third molar than males.
 4. Pathak S, Mishra N, Rastogi ,Sharma S. Significance of Radiological Variables Studied on Orthopantomogram to Predict Post-Operative Inferior Alveolar Nerve Paresthesia after Third Molar Extraction. Journal of Clinical and Diagnostic Research. 2014 ;Volume 8(5):62-ZC64
 5. Saad SS, Al-Saffar AB, Minwah BS. Relation of the Mandibular Canal to the Root Apices of Different Types of Impacted Lower 3rd Molar. Al-Rafidain Dent J(2012); Volume 12(1): 109-114.
 6. Rood JP and ShehabBA..The radiological prediction of inferior alveolar nerve injury during third molar surgery. Br J Oral Maxillofac Surg.1990;28(1):20-5.
 7. Hazza'a AM, Z. S. M. Albashaireh, A. B. Bataineh,.The relationship of the inferior dental canal to the roots of impacted mandibular third molars in Jordanian population. Journal of Contemporary Dental Practice.2006;7(2):1-9
 8. Chaurasia A, Pandey A, Sharma A. Evaluate of Position of Impacted Mandibular Third Molars and Their Relationship with the Inferior Alveolar Canal With Panoramic Radiographs. Indian Journal of Applied Research 2019 ; Volume 9(3): 16-18
 9. Tassoker M. Diversion of the mandibular canal: Is it the best predictor of inferior alveolar nerve damage during mandibular third molar surgery on panoramic radiographs? Imaging Science in Dentistry 2019; Volume 49: 213-8
 10. Leung Y Y, Cheung L K. Correlation of Radiographic Signs, Inferior Dental Nerve Exposure, and Deficit in Third Molar Surgery. Journal of Oral Maxillofacial Surgery 2011; Volume 69:1873-1879
 11. Ranjan V, Jangid M, Bhargava R, Arya S, Bhora A, Devi N P . Relationship Of Impacted Third Molar With Inferior Alveolar Nerve: - A Retrospective Study. International Journal Of Current Medical And Pharmaceutical Research(2017); Volume 3(5):1677-1680