

# Computed tomographic prevalence of intracranial calcification of pineal gland in apparently normal individuals

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## Abstract

**Introduction:** This study was undertaken to know the prevalence of pineal calcification in normal individuals of south central Maharashtra with the objective to study the age related variation, the sexual variations in the prevalence of normal pineal gland calcification. It increased from 2.22% in the first decade to 57.5% in seventh decade with statistically significant rise from 13.33% to 26.66% from second to third decade. Considering the process of calcification, endocrine activity of pineal gland and the significant rise in the prevalence of calcification after second decade, it was concluded that secretions of pineal gland may influence sexual hormone and the gland is more active in second and third decade of life.

**Keywords:** Intracranial Calcification, Pineal Gland, CT scan.

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## INTRODUCTION

Intracranial calcification can be physiological or pathological, often due to mineral (e.g. calcium) or metal (e.g. iron) deposition in the blood vessels, glands, cortices or other structures within the brain. CT is the most sensitive means of detecting intracranial calcifications. Physiological brain calcification is common and occurs in males and females at any age and of any ethnicity; Daghighi *et al*<sup>1</sup> studied 1569 CT scans of patients ranging in age from 15 years to 85 years and a large percentage had physiological calcifications as follows: 71.0% had pineal gland calcifications, 66.2% had choroid plexus calcifications, 20.1% had habenular calcifications, 7.3% had tentorium cerebelli, sagittal sinus or falx cerebri calcifications, 6.6% had vessel calcifications, 0.8% had basal ganglia calcification and 0.9% had lens and other

non-defined structure calcifications. The pineal gland is calcified in an increasing proportion of the individuals as they grow older. Thus it is rare to see calcified pineal gland in the X ray of skull of the child, but the same is frequently seen in elderly persons. In general population, a little over half the skull X rays will show pineal calcification. Calcified pineal gland lies in midline in routine skull radiography with coronal centering. Displacement of more than 3mm to one side can be regarded as pathological (Sutton, 1987).<sup>2</sup> Study of morphology, location and frequency of such physiological calcification is important to differentiate it from pathological calcification. Extensive studies have been carried out regarding calcification of the pineal gland. The first radiological study was done by Schuller (1989). He reported pineal calcifications on conventional radiography.<sup>3</sup> However such studies are less on cranial computed tomography (CT). The racial differences of such calcifications were found to be significant in some of such studies (Adeloye and Felson, 1974).<sup>4</sup> Before advent of CT scan, studies were done with conventional radiologic techniques, where there was difficulty in identification and differentiation of calcifications. In subsequent studies done with CT scan, percentage of normal calcifications has been increased which is due to better sensitivity of CT scan than plain X ray. In view of rarity of published work in this subject on population of Maharashtra, the present study was undertaken to find out

prevalence of calcification of pineal gland and to find out variations due to sex and age in the pattern of such calcification. Therefore in this study, CT scan was selected to study the prevalence of normal calcification of pineal gland.

**MATERIALS AND METHODS**

A total of 407 non enhanced CT scans of standardized patients between the age group of 1-80 years were evaluated to find out the prevalence of calcification of pineal gland. These 407 patients (221 male, 186 females) were standardized from total 1000 patients examined (500 male, 500 females). CT scan of patients, showing pathologies like tuberculoma, cysticercosis, craniopharyngioma, cerebral hemorrhage were excluded from the study. CT scans with minimal head injury and absolutely normal scans were considered for the study as minimal head injury of recent history does not affect intracranial calcification. CT scans were performed at Rajiv CT scan centre, Solapur Rughalay where patients are usually referred from whole Solapur, Osmanabad and Latur districts. Axial scans were performed in all the patients on GE CT scanner having matrix of 256x256. A minimum of 12 slices were taken in all the patients, the slice thickness being 5-10mm. The sections were angled parallel to orbito-meatal plane with centre value between 10-15 Hounsefield unit (HU) and window width between 50-150 HU. Normal calcifications were studied in respect to size, shape and attenuation value in Hounsefield unit. Those calcifications are taken as normal which occur in certain defined areas of brain or meninges and are unrelated to general status of individual (Schey 1974). [5] Calcification above 80 HU were included in normal calcifications. The observations were analyzed with class interval of 10 years and in males and females differently. As the data was quantitative Z test of statistical significance was applied to find out the significance in the variation of prevalence.

**RESULTS**

A total 407 cases from a total of 1000 patients were selected for the present study. Of these, 221 were males and 186 females. The age groups of these patients were ranging from 1 year to 80 year (Table 1).

**Table 1:** Showing the distribution of the data according to age and sex

| Age groups   | Males      | Females    | Total      |
|--------------|------------|------------|------------|
| 1 to 10      | 21         | 24         | 45         |
| 11 to 20     | 30         | 30         | 60         |
| 21 to 30     | 36         | 39         | 75         |
| 31 to 40     | 42         | 30         | 72         |
| 41 to 50     | 25         | 15         | 40         |
| 51 to 60     | 38         | 20         | 58         |
| 61 to 70     | 19         | 21         | 40         |
| 71 to 80     | 10         | 7          | 17         |
| <b>Total</b> | <b>221</b> | <b>186</b> | <b>407</b> |

Pineal gland calcification increases with increase in age of patient. While studying age related changes, in the prevalence of calcification of pineal gland the results were tabulated with the class interval of 10 years (Table 2). Prevalence of calcification in the first decade of life was found to be 2.22%; which increased to 13.33% in second decade, 26.66% in the third decade, 29.16% in fourth decade, 35% in fifth decade, 37.93% in sixth decade, 57.5% in seventh decade, and little decreased in eighth decade to 52.94%. In 118 patients, pineal gland was found to be calcified (Table 2). All these were normal physiological calcification (physiological calcification are those which occur in certain defined areas of the brain or meninges and are apparently unrelated to the general status of an individual). So prevalence of pineal gland calcification in this study was found to be 29%. Out of 221 males, 68 had calcified pineal gland. So prevalence of calcification was found to be 30.76%, whereas in females it was 26.88%. This difference was statistically not significant (Z test 0.872 < 1.96, p value > 0.05).

**Table 2:** Shows the prevalence of calcification of pineal gland with increasing age

| No | Age groups   | Males       |                                 |              | Females     |                                 |              | Total       |                                 |             |
|----|--------------|-------------|---------------------------------|--------------|-------------|---------------------------------|--------------|-------------|---------------------------------|-------------|
|    |              | Total cases | Cases with pineal calcification | Prevalence   | Total cases | Cases with pineal calcification | Prevalence   | Total cases | Cases with pineal calcification | Prevalence  |
| 1  | 1 to 10      | 21          | 0                               | 0            | 24          | 1                               | 4.16         | 45          | 1                               | 2.22        |
| 2  | 11 to 20     | 30          | 3                               | 10.0         | 30          | 5                               | 16.66        | 60          | 8                               | 13.33       |
| 3  | 21 to 30     | 36          | 9                               | 25           | 39          | 11                              | 28.20        | 75          | 20                              | 26.66       |
| 4  | 31 to 40     | 42          | 12                              | 28.57        | 30          | 9                               | 30.0         | 72          | 21                              | 29.16       |
| 5  | 41 to 50     | 25          | 10                              | 40.0         | 15          | 4                               | 26.66        | 40          | 14                              | 35.0        |
| 6  | 51 to 60     | 38          | 19                              | 50.0         | 20          | 3                               | 15.0         | 58          | 22                              | 37.93       |
| 7  | 61 to 70     | 19          | 11                              | 57.89        | 21          | 12                              | 57.14        | 40          | 23                              | 57.5        |
| 8  | 71 to 80     | 10          | 4                               | 40.0         | 7           | 5                               | 71.42        | 17          | 9                               | 52.94       |
|    | <b>Total</b> | <b>221</b>  | <b>68</b>                       | <b>30.76</b> | <b>186</b>  | <b>50</b>                       | <b>26.88</b> | <b>407</b>  | <b>118</b>                      | <b>29.0</b> |

**DISCUSSION**

Prevalence of calcification of pineal gland, in present study was found to be 29 % (118 cases out of 407). In the males the prevalence was found to be 30.76%, and in females it was 26.88%. This difference between male and females was found to be statistically insignificant (Z test value 0.87, 1.96 so P.0.05). There was rise in the prevalence of pineal gland calcification from first decade to seventh decade. After which there was a little drop. However this drop was to be statistically insignificant (Z test value 0.31, 1.96 so p.0.05) Significant difference was noted between second to third and third to fourth decade of life. The prevalence of calcification, which was only 13.33% in second decade, increased to 26.66% in the third decade and 29.16% in the fourth decade of life. Z test of significance showed the Z value to be 1.98 and 3.37 respectively, indicating that these differences are highly significant (p 0.005) There was further rise in the prevalence of calcification from fourth decade onward, too. Prevalence which was 29.16% in the fourth decade, increased to 35% in the fifth, 37.93% in the sixth, 57.5% in the seventh decade. However this rise was not statistically significant. The significant rise in the calcification after second decade of life can be correlated with the role of pineal gland in the onset of puberty, mechanism of calcification of pineal gland is related with secretion of polypeptides and melatonin, during secretion of which calcium is taken in the gland (Lukaszyc and Ritter, 1975).<sup>6</sup> Hence it can be stated that calcification indicates the activity of the gland. Haga and Alfidu (1988) stated that calcium corpuscles can be seen histologically in the pineal gland right at the birth.<sup>7</sup> These finding are similar to the findings of Kohli *et al* (1997).<sup>8</sup> In their study, prevalence of calcification was 1.16 %in the first decade which increased to 31.88% in the sixth decade. There was spurt in the prevalence of calcification from second to third decade which was also statistically significant. They explained that thick rise coincides fairly

with the onset of hormonal changes which precede puberty. But they also noted significant increase in the percentage of calcification in the sixth decade, the cause of which remained unexplained.

The percentage of calcification of pineal gland was found to be 7.6% in the study of Srivastava and Prusty (1986), which is comparatively less than the present study.<sup>9</sup> Their study was carried out with conventional X-rays which is many times less sensitive compared to CT scan in detection of calcification.

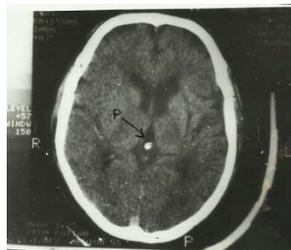
These variations in the findings of different studies are due to

1. Variations in the age groups of individuals on whom study is done.
2. Difference in the sensitivity of radiological technique which is used.
3. Genetic makeup of the population examined (Zimmerman, 1982).<sup>10</sup>

Adeloye and felson (1974) had proved the same after studying the percentage of calcification of pineal gland in black and white Americans. They found the percentage to be 9.7 % and 16% respectively in them. They concluded that constitutional factors are more important than the environmental factors for the calcification.<sup>4</sup> In the present study, the youngest individual with normal calcification of pineal gland was the child of 2 years of age. The follow up CT scan after 6 months didn't reveal any pineal or parapineal abnormality. The youngest individual with normal calcification of pineal, in the study of kohli *et al* (1992) was of 6. 5 yrs of age.<sup>7</sup> Zimmerman (1982) also found the same in a child of 6 1/2 years. <sup>9</sup>Schey (1974), who studied frequency of intracranial calcification in childhood, concluded that normal calcification were almost never seen under age of 6 years.<sup>5</sup> On the contrary, Hardwood-Nash and Fitz (1976) stated that normal calcification of pineal gland can be shown in a child as young as 2years of age.<sup>11</sup> Our finding is in agreement with Hardwood-Nash study.

**Table3:** Showing Comparison in Principal Findings among Kolhi *et al* and the Present Study

| Site of calcification | Reference          | Percentage of calcification in different decades |        |       |        |       |       |         |
|-----------------------|--------------------|--|--------|-------|--------|-------|-------|---------|
|                       |                    | First  | Second | Third | Fourth | Fifth | Sixth | Seventh |
| Pineal gland          | Kolhi <i>et al</i> | 1.16   | 5.96   | 17.65 | 23.22  | 25.64 | 31.88 | --      |
|                       | Present study      | 2.22   | 13.33  | 26.66 | 29.16  | 35    | 37.93 | 57.5    |



**Figure 1:** CT scan image showing calcified pineal gland

## CONCLUSION

Physiological calcifications are those which are found in certain defined areas of the brain and are apparently unrelated to the general status of individual. The common sites for this are pineal gland, habenular commissure, choroid plexus, dura matter. A total 407 standardized CT scans were studied from a total 1000 at Rajiv CT scan centre, Solapur. Those scans were excluded from the study which were showing any pathology or suspicion of any pathology. The prevalence of calcification of pineal gland was found to be 29%. In males it was 30.76% and in females it was 26.88%. It increased from 2.22% in the first decade to 57.5% in seventh decade with statistically significant rise from 13.33% to 26.66% from second to third decade. Considering the process of calcification, endocrine activity of pineal gland and the significant rise in the prevalence of calcification after second decade, it was concluded that,

1. Pineal gland is active gland and not the vestigial organ
2. Secretions of pineal gland are influencing sexual hormone
3. Pineal gland is more active in second and third decade of life.
4. The rise in the calcification in the later age group indicates that the gland is active throughout the life.

But why does not pineal gland calcify in all the individuals remains unexplained and needs further detail studies.

Youngest individual with calcification of pineal gland was of 2 years of age. Majority of the studies show that calcification is rarer under 10 years of age and one should look at it with greater suspicion for pathological causes. The present study showed that calcification of pineal

gland can be demonstrated on CT scan at earliest age of 2 years. In no case, calcification of pituitary gland, interclinoid ligament or tentorium cerebelli was observed.

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