$$yy_1 - 2ax = y_1^2 - 2ax_1 = 2ax_1 \quad \because \; y_1^2 = 4ax_1$$

Hence Tangent at (x_1, y_1) is $yy_1 - 2ax = 2ax_1$

We may write then $p = \dfrac{2ax_1}{\sqrt{y_1^2 + 4a^2}} = \dfrac{2ax_1}{\sqrt{4a(x_1+a)}}$

$$\therefore \; p^2 = \frac{4a^2x_1^2}{4(x_1+a)} \quad \text{or,} \quad p^2(x_1+a) = ax_1^2$$

$$\text{or,} \quad ax_1^2 - p^2x_1 - ap^2 = 0$$

$r^2 = x_1^2 + y_1^2$ gives $x_1^2 + 4ax_1 - r^2 = 0$

$$\frac{x_1^2}{p^2r^2 + 4a^2p^2} = \frac{x_1}{a(r^2 - p^2)} = \frac{1}{4a^2 + p^2}$$

$(p-r)$ eqn. $(p^2r^2 + 4a^2p^2)(4a^2 + p^2) = a^2(r^2 - p^2)^2$