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$n = k+1$

$$\frac{1}{6} + \frac{1}{12} + \dots + \frac{1}{k^2+3k+2} + \frac{1}{k^2+5k+6} \stackrel{?}{=} \frac{k+1}{2k+6}$$

$$\frac{k}{2(k+2)} + \frac{1}{(k+3)(k+2)} \stackrel{?}{=} \frac{k+1}{2(k+3)}$$

$$\frac{k^2+3k+2}{2(k+2)(k+3)} \stackrel{?}{=} \frac{k+1}{2(k+3)}$$

$$\frac{\cancel{(k+2)}(k+1)}{2\cancel{(k+2)}(k+3)} = \frac{k+1}{k+3}$$