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Trifluoromethanesulfonic Acid-Catalyzed Tandem Semi-Pinacol Rearrangement/Alkyne-Aldehyde Metathesis Reaction of Arylpropagylsulfonamide-Tethered 2,3-Epoxycyclohexan-1-ols to Spiropiperidines

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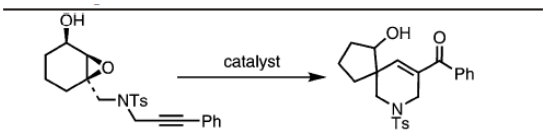
Table 1. Optimization of the reaction conditions.



1a **2a**

Entry	Catalyst	Solvent	*T* [°C]	*t*	Yield [%] (*dr*)[a]
1	5% $PPh_3Au/AgOTf$	DCM	24	10 h	33 (58:42)
2	10% BF_3•OEt_2	THF	24	2.0 h	46 (52:48)
3	10% $AgSbF_6$	DCE	24	3.0 h	60 (48:52)
4	10% $NHTf_2$	DCE	24	0.5 h	83 (67:33)
5	10% TfOH	DCE	24	3.5 h	86 (49:51)
6	10% TfOH	DCE	50	40 min	91 (76:24)
7	10% TfOH	DCM	50	2.0 h	64 (73:23)
8	10% TfOH	THF	50	2.5 h	52 (63:37)
9	10% TfOH	toluene	50	2.0 h	57 (37:63)
10	10% TfOH	MeCN	50	4.0 h	33 (69:31)

[a] Diastereoisomeric ratio.

Scheme 1. Plausible reaction mechanism for the TfOH-catalyzed cycloisomerization of **1** to **2**.

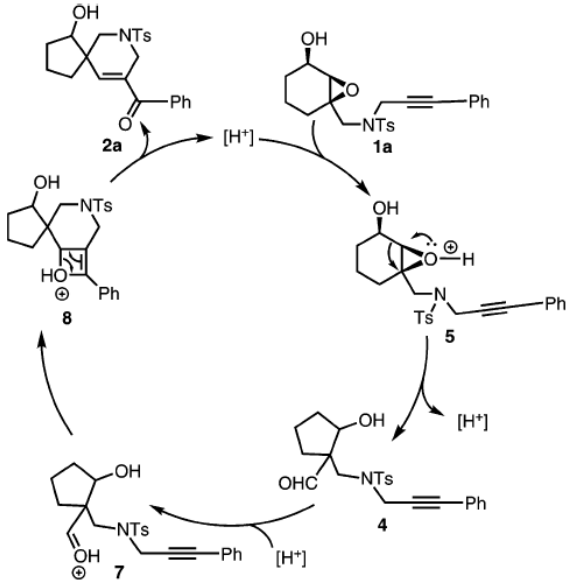
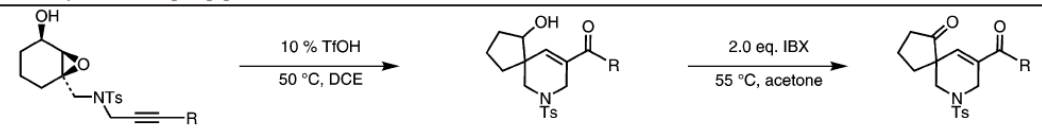


Table 2. Synthesis of spiropiperidines **2**.



1 **2** **3**

Entry	Substrate	R	*t*	Product[a]	Yield [%] of **2** (*dr*)	Yield of **3** [%][b]
1	**1a**	phenyl	40 min	**2a**	91 (76:24)	87
2	**1b**	4-methoxyphenyl	10 min	**2b**	84 (54:46)	79
3	**1c**	4-methylphenyl	30 min	**2c**	76 (67:33)	72
4	**1d**	4-phenylphenyl	15 min	**2d**	81 (58:42)	76
5	**1e**	1-naphthyl	10 min	**2e**	86 (57:43)	81
6	**1f**	9-phenanthryl	15 min	**2f**	66 (50:50)	61
7	**1g**	4-bromophenyl	4 h	**2g**	56 (38:62)	53
8	**1h**	2-bromophenyl	3 h	**2h**	48 (44:56)	43
9	**1i**	2-ethoxycarbonylphenyl	2 h	**2i**	28 (52:48)	26
10	**1j**	3-ethoxycarbonylphenyl	2 h	**2j**	51 (52:48)	48
11	**1k**	4-nitrophenyl	8 h	**2k**	14 (44:56)	13
12	**1l**	CH_3	30 h	**2l**	21 (29:71)	20
13	**1m**	H	1 h	**2m**	0 -	0

[a] All products **2** were subjected to IBX oxidation and characterized as 9-aroyl-7-tosyl-7-azaspiro[4.5]dec-9-en-1-ones **3**.