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Diastereoselective Synthesis of Enantiopure Morpholines by Electrophilic Selenium-Induced 6-*exo* Cyclizations on Chiral 3-Allyl-2-hydroxymethylperhydro-1,3-benzoxazine Derivatives

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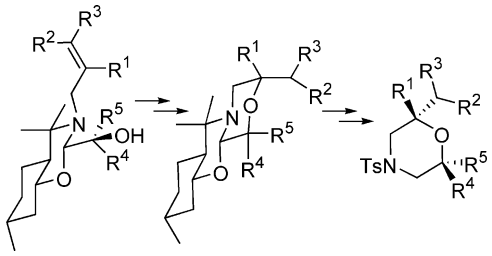

Enantiopure morpholine derivatives have been prepared by selenocyclofunctionalization of chiral 3-allyl-2-hydroxymethyl-substituted perhydro-1,3-benzoxazine derivatives. The cyclization occurs in high yields and diastereoselection, although the temperature of the reaction and the structure of the substituent at C-2 and the substitution pattern of the double bond can modify the regio- and stereochemistry of the final products.

Introduction

Electrophile-mediated cyclofunctionalization of alkenes containing an internal nucleophile is a versatile cyclization reaction in organic synthesis.[1] The reaction is of general scope because of the great variety of electrophile species that induce the cyclization and the functional groups that act as nucleophiles in the process. The use of organoselenium reagents for selenocyclofunctionalization reactions was already described 45 years ago,[2,3] and it has advantages due to the synthetic interest of the introduced arylselenyl group.[4] Among the transformations of the selenenyl group, the oxidation-*syn*-selenoxide elimination, the nucleophilic substitution of the corresponding selenones, and the radical transformations are of special interest. Consequently, a wide range of heterocyclic compounds such as lactones,[5] cyclic ethers[6] and amines,[7] sulfur heterocycles,[6b] lactams,[8] isoxazolidines,[9] oxazolines,[10] piridazines,[11] pirazolidines,[12] 1,2-oxazines,[13] thiazolines,[14] and spiroketals[15] have been prepared in this way.

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In the cyclization, two contiguous stereocenters can be created and the reaction proceeds through an anti attack of the electrophile and nucleophile to the double bond. The regio- and stereochemical outcome of the cyclization is strongly influenced by the experimental conditions of the reaction, the stereochemistry of the double bond, and the configuration of stereogenic centers near the double bond.[16] The nature of the selenium electrophile and the counterion as well as the solvent and external additives influence not only the regio- and stereochemistry but also the chemoselectivity of the cyclization.[17]

Several research groups have employed chiral organoselenium reagents[18] as electrophiles for the control of the stereochemistry of these addition reactions, but for aliphatic alkenes only a few chiral selenium electrophiles lead to high selectivities.[18b] In most cases, 5-*exo* and 5-*endo* cyclizations have been developed, a few examples of diastereoselective 6-*exo* cyclizations are described,[19] and the use of chiral auxiliaries in diastereoselective selenocyclizations has been not studied.[20]

Recently, we have shown that perhydro-1,3-benzoxazines derived from (−)-8-aminomenthol[21] are useful chiral templates in the synthesis of enantiopure nitrogen heterocyclic compounds by different diastereoselective cyclization processes.[22,23] Selenenylperhydro-1,3-benzoxazine derivatives have been also prepared by regio- and stereoselective methoxyselenenylation of chiral 2-vinyl[24] and 3-allylperhydro-1,3-benzoxazines.[25]

We now report on the synthesis of enantiopure morpholine derivatives by selenocyclofunctionalization of chiral 3-allyl-2-hydroxymethy-substituted perhydro-1,3-benzoxazine derivatives. The morpholine rings have attracted a great deal of attention due to their presence in a number of therapeutically and biologically active compounds,[26,27] agrochemical fungicides and bactericides,[28] or chiral reagents;[29] in recent years, several syntheses of enantiopure morpholines have appeared in the literature.[30]

Results and Discussion

The starting chiral perhydro-1,3-benzoxazines **4a**−**e** were prepared in three steps as single diastereomers, in good to

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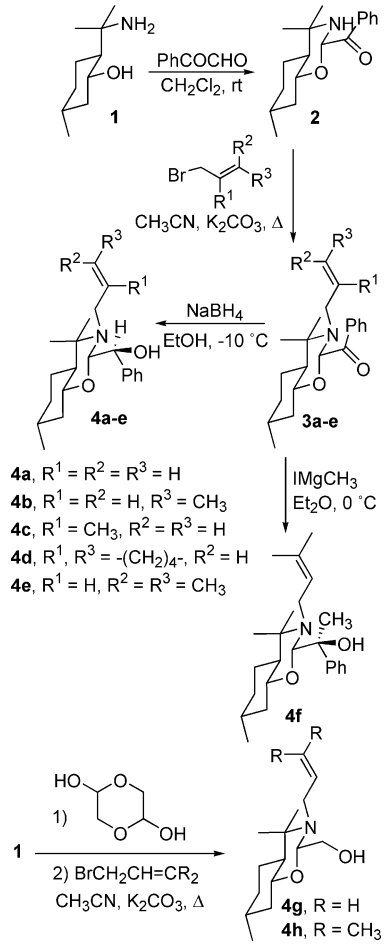
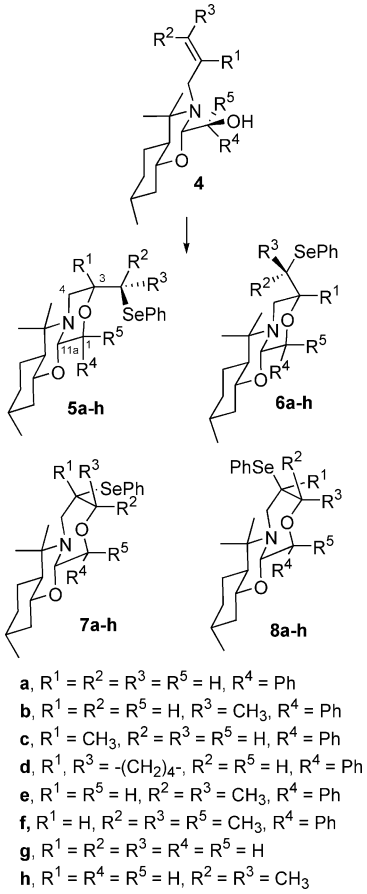
SCHEME 1. Synthesis of Perhydrobenzoxazines 4a−h



SCHEME 2. Diastereoselective Selenocyclofunctionalization of Alcohols 4a−h



excellent yield, as summarized in Scheme 1. Condensation of (−)-8-aminomenthol **1** with phenylglyoxal quantitatively afforded **2**, which was alkylated with allyl bromides in the presence of potassium carbonate in refluxing acetonitrile[31] to give **3a**−**e**. These compounds were converted into the final alcohols **4a**−**e** with good chemical yields and excellent diastereoselectivity (de > 92%) by reduction of the carbonyl group with sodium borohydride in ethanol at −10 °C.[32] Carbinol **4f** was obtained in 96% yield and de > 94%, by addition of methylmagnesium iodide to ketone **3e** in diethyl ether at 0 °C. After purification by flash chromatography and/or recrystallization, all of these compounds were obtained as single diastereomers and their absolute configuration were assigned as *S* in agreement with Eliel's reports[32] and confirmed on the cyclized products **5** and **6** (vide infra). Alcohols **4g**[33] and **4h**[31] were obtained by condensation of **1** with glycolaldehyde dimer and *N*-allylation of the resulting 2-hydroxymethyl perhydro-1,3-benzoxazine with allyl and prenyl bromide, respectively.

Selenocyclofunctionalization of alcohols **4a**−**h** was tested under different reaction conditions and with different selenium reagents, and, after extensive experimentation, we found that the cyclic products were obtained in moderate to good yields and stereoselection using benzeneselenenyl chloride as electrophile in CH_2Cl_2 in the presence of $SnCl_4$ or in THF with methanol as an additive. The results are summarized in Scheme 2 and Table 1.

The allyl derivative **4a** reacted with PhSeCl in THF−MeOH at −78 °C (method C, entry 3 in Table 1), leading to an almost equimolar mixture of the two exo diastereomers **5a** and **6a** in low yield. By contrast, the reaction showed a high degree of stereoselection in CH_2Cl_2 in the presence of 1 equiv of $SnCl_4$[34] at −78 °C (method A, entry 1), and **5a** and **6a** were obtained in a 92:8 ratio, although with moderate yield (60%). Low temperature is needed for a good level of stereoselection because the same reaction at −15 °C led to a poor 57:43 diastereomeric ratio. By contrast, when the reaction was carried out in CH_2Cl_2 at 0 °C in the presence of solid K_2CO_3 (method B, entry 2), the stereoselection was reversed and the diastereoisomers **5a** and **6a** were obtained in a 28:72 ratio (72% total yield). Cyclization of **4a** occurred with total regioselectivity, and only exo cyclization products were obtained in all conditions examined; endo cyclization products **7a** and **8a** were not detected by ^1H NMR in the reaction mixtures.

The best diastereoselection was obtained in the cyclization of the crotyl derivative **4b**, which furnished a single exo

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TABLE 1. Cyclofunctionalization of Perhydrobenzoxazines 4a−h Induced by Benzeneselenenyl Chloride

entry	alcohol	method[a]	yield[b] (%)	exo/endo ratio[c] (%)	exo products ratio[c] (%)	endo products ratio[c] (%)
1	**4a**	A	60	100/0	**5a** (92)/**6a** (8)	
2	**4a**	B	72	100/0	**5a** (28)/**6a** (72)	
3	**4a**	C	41	100/0	**5a** (46)/**6a** (54)	
4	**4b**	A	56	100/0	**5b** (>96)	
5	**4b**	B	68	100/0	**5b** (26)/**6b** (74)	
6	**4b**	C	47	100/0	**5b** (34)/**6b** (66)	
7	**4c**	A	92	100/0	**5c** (87)/**6c** (13)	
8	**4c**	B	89	100/0	**5c** (43)/**6c** (57)	
9	**4c**	C	82	100/0	**5c** (48)/**6c** (52)	
10	**4d**	A	92	100/0	**5d** (83)/**6d** (17)	
11	**4d**	B	45	100/0	**5d** (93)/**6d** (7)	
12	**4e**	A	90	7/93	**6e** (>96)	**7e** (>96)
13	**4e**	B	40	58/42	**5e** (47)/**6e** (53)	**7e** (70)/**8e** (30)
14	**4e**	C	83	100/0	**6e** (>96)	
15	**4f**	A	90	100/0	**5f** (74)/**6f** (26)	
16	**4f**	B	92	100/0	**5f** (92)/**6f** (8)	
17	**4f**	C	68	100/0	**5f** (83)/**6f** (17)	
18	**4g**	A	93	100/0	**5g** (75)/**6g** (25)	
19	**4g**	B	90	100/0	**5g** (40)/**6g** (60)	
20	**4h**	B	83	68/32	**5h** (28)/**6h** (72)	**7h** (47)/**8h** (53)
21	**4h**	C	52	81/19	**6h** (>96)	**8h** (>96)

[a] Method A: PhSeCl, $SnCl_4$, CH_2Cl_2, −78 °C, 2 h. Method B: PhSeCl, K_2CO_3, CH_2Cl_2, 0 °C, 5 h. Method C: PhSeCl, THF−MeOH 40:1, −78 °C, 8 h. [b] Yield refers to pure compounds after column chromatography. [c] Determined by ^1H NMR on the reaction mixtures.

cyclization product **5b**, although in moderate yield (entry 4). Excellent yields and good levels of regio- and stereoselection were also maintained in selenocyclofunctionalization of the methallyl and the cyclohexenyl derivatives **4c** and **4d**, substituted at the inner carbon of the double bond when reacted with PhSeCl in the presence of $SnCl_4$ at −78 °C (entries 7 and 10). Interestingly, in these conditions, the secondary alcohol **4e** disubstituted with two methyl groups in the terminal position of the double bond mainly furnished the endo product **7e** (in agreement with Markovnikov's rule) together with a 7% of the exo product **6e** (entry 12). However, the tertiary alcohol **4f** with a similar substitution at the double bond only provided a mixture of the two exo cyclization products **5f** and **6f** in a 74:26 ratio, and endo products were not detected in the reaction mixture by ^1H NMR (entry 15). This effect (anti-Markovnikov's rule) due to the increase substitution about the carbinol has been previously described.[35] The behavior of compounds **4b** and **4c** in CH_2Cl_2 in the presence of PhSeCl and K_2CO_3 at 0 °C is similar to that of **4a**, and the cyclization turned out with total regioselectivity and reversed stereoselectivity (entries 5 and 8). Compounds **6b** and **6c** were obtained as major products, respectively, although with poor diastereoselection. On the contrary, the sense of the diastereoselection is not reversed when **4d** and **4f** were cyclized with PhSeCl in the presence of K_2CO_3 at 0 °C in CH_2Cl_2 (entries 11 and 16), and these are the best reaction conditions to obtain **5f** (**5f**:**6f** 92:8, 92%), although **4d** only cyclized in 45% yield but with excellent diastereoselectivity (**5d**:**6d** 93:7).

A mixture of exo and endo cyclization products was formed by reaction of **4e** with PhSeCl and potassium carbonate in CH_2Cl_2 at 0 °C. In this case, both the regio- and the diastereoselectivity are very low (entry 13). By contrast, the exo product **6e** was obtained as a single diastereoisomer when **4e** reacted with PhSeCl in THF−MeOH at −78 °C (entry 14). The presence of 2.5% of methanol was found to be essential for a good yield and diastereoselection. However, this good result seems to be quite unique for **4e** because in these conditions **4a** and **4c** cyclized to an almost equimolar mixture of exo products (entries 3 and 9), whereas **4b** provided the exo products in moderate stereoselectivity (entry 6).

With the purpose to evaluate the influence and contribution exerted in the asymmetric induction by the stereocenter at the carbon bearing the hydroxyl group, we tested the behavior of the *N*-allylperhydrobenzoxazine **4g** and **4h**, with a primary hydroxyl group. The diastereoselection in the reaction of **4g** with PhSeCl in CH_2Cl_2 at −78 °C in the presence of $SnCl_4$ or at 0 °C in the presence of K_2CO_3 was lower than that obtained for the allyl derivative **4a** (compare entries 18 and 19 versus 1 and 2). However, selenocyclofunctionalization of **4h** in THF−MeOH at −78 °C led to a mixture of two regioisomers with good regioselectivity (**6h**:**8h** 81:19) and total diastereoselectivity, comparable to that obtained in the cyclofunctionalization of **4e** in similar conditions (compare entries 21 and 14). The reaction of **4h** with PhSeCl in the presence of K_2CO_3 furnished a mixture of the four possible products, and the chemical yield, regioselectivity, and stereoselectivity in exo products were better than those obtained for **4e**, but the stereoselectivity in endo products was poorer.

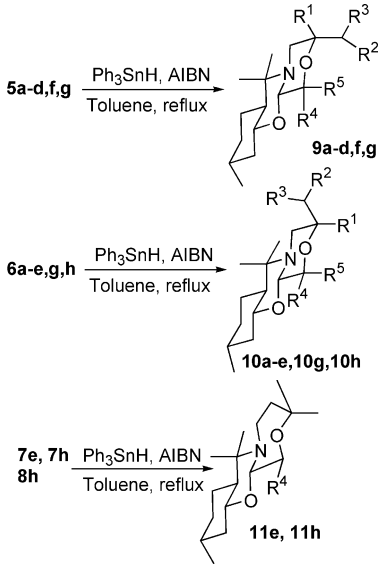
The diastereoisomers formed in each reaction were isolated and purified by flash chromatography and/or crystallization, and their structure was determined on the basis of ^1H and ^{13}C NMR spectra. The regiochemistry was also confirmed by reductive deselenenylation with triphenyltin hydride in the presence of catalytic amounts of AIBN in refluxing toluene (Scheme 3).[36] As expected, deselenenylation of **5c** and **6c**, and **5d** and **6d**, led to the same morpholines **9c** and **9d**, respectively, whereas deselenenylation of **7h** and **8h** led to the same 1,4-oxazepane **11h**. Deselenylation of the mixture of **6h** and **8h** allowed for the isolation of pure morpholine derivative **10h**.

The stereochemistry of **5a**−**d**, **6a**−**c**, and **6e**−**f** was determined from COSY and NOESY experiments. The NOESY

(35) Vukicevic, R.; Konstantinovic, S.; Mihailovic, M. L. *Tetrahedron* **1991**, *47*, 859.

(36) Clive, D. L. J.; Chittattu, G. J.; Farina, V.; Kiel, W. A.; Menchen, S. M.; Russell, C. G.; Singh, A.; Wong, C. K.; Curtis, N. J. *J. Am. Chem. Soc.* **1980**, *102*, 4438.

SCHEME 3. Deselenenylation of Compounds 5a−g, 6a−h, 7e, 7h, and 8h



contacts point to a trans equatorial−equatorial fusion of the chair morpholine ring and the perhydro-1,3-benzoxazine, with a trans relationship between the substituents R^1 and R^5 for **5a**−**d** and cis for **6a**−**c** and **6e**,**f** (Figure 1 summarizes the observed effects for compounds **5a** and **6a**). The vicinal coupling constants between H-3 and H-4_{ax} corroborated these observations (J_{3-4ax} = 3.2 Hz, 3.1 Hz for **5a** and **5b**, and J_{3-4ax} = 10.8−10.3 Hz for **6a**,**b** and **6e**,**f**). These coupling constants are consistent with an equatorial arrangement of H-3 in **5a** and **5b**, and an axial arrangement in **6a**,**b** and **6e**,**f**. The absolute stereochemistry for **6f** was confirmed by X-ray diffraction analysis.[37]

On the other hand, the NOESY spectra of **5f**, **5g**, and **5h** showed that the substituent at the nitrogen atom of the benzoxazine ring is in axial arrangement. For these compounds, the fusion of the 1,3-benzoxazine ring and the morpholine was established as a cis axial−equatorial fashion (see Figure 1). Moreover, the H-3 signal in the ^{1}H NMR spectra of **5f** and **5h** appears as a dd with coupling constants (J_{3-4ax} = 10.3−10.4 Hz and J_{3-4eq} = 2.3 Hz) consistent with an axial arrangement of this proton. The coupling constants for H-3 and H-4_{ax} (J_{3-4ax} = 10.8 Hz) and for H-3 and H-4_{eq} (J_{3-4eq} = 4.0 Hz) are also consistent with an axial arrangement of H-3 in compound **5g**. The configuration of **6h** was assigned assuming an anti addition on the basis of the literature precedents.

The stereochemistry of compound **6g** was also established on the basis of their ^{1}H NMR spectra. Thus, the signals for H-11a, attached to the *N*,*O*-acetallic carbon atom, appear as a dd with coupling constants $J_{11a-1ax}$ = 8.7 Hz and $J_{11a-1eq}$ = 3.7 Hz consistent with an axial arrangement for this hydrogen atom. The signal for H-3 appears as two dd with coupling constants J_{3-4ax} = 9.9 Hz and J_{3-4eq} = 2.2 Hz, as well consistent with a similar axial arrangement.

The configuration of **6d** was assigned by assuming an anti addition, and taking into account that the reductive deselenenylation of **5d** and **6d** led to the same morpholine **7d**.

Finally, the configuration of the stereocenters in **7e** was determined by its conversion into the 1,3-amino alcohol **12** by

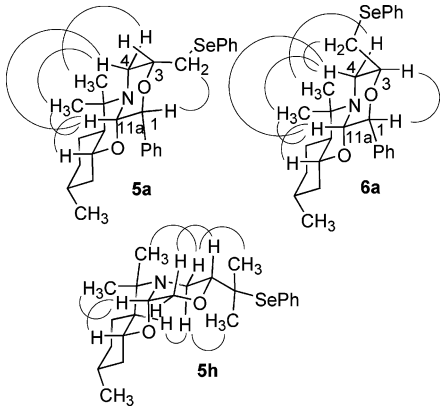
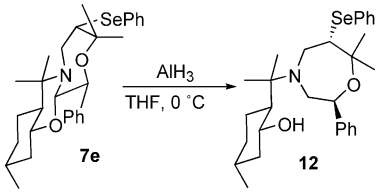


FIGURE 1. ^{1}H NOESY contacts recorded for compounds **5a**, **5b**, and **5h**.

SCHEME 4. Stereochemical Correlation of Compound 7e



nucleophilic ring opening of the *N*,*O*-acetal moiety by aluminum hydride (Scheme 4) and X-ray diffraction analysis of **12**.[37]

The transformation of some deselenenylation products into the final chiral, nonracemic morpholines was carried out in two steps as depicted in Scheme 5. Treatment of **9a**,**c**,**f**,**g** and **10a**,**b**,**e**,**g**,**h** with aluminum hydride in THF led to the aminomenthol derivatives **13a**,**c**,**f**,**g** and **14a**,**b**,**e**,**g**,**h** in good to excellent yields. The elimination of the menthol appendage in these amino alcohols was carried out by oxidation with PCC in CH_2Cl_2 at room temperature to 8-aminomenthone derivatives, which, without isolation, were treated with KOH in THF−MeOH−H_2O,[38] leading to the final enantiopure morpholines. These compounds were isolated and characterized as *N*-tosyl derivatives **15a**,**c**,**f**,**g** and **16a**,**b**,**e**,**g**,**h** by treatment with tosyl chloride and diisopropylethylamine in ethyl acetate.

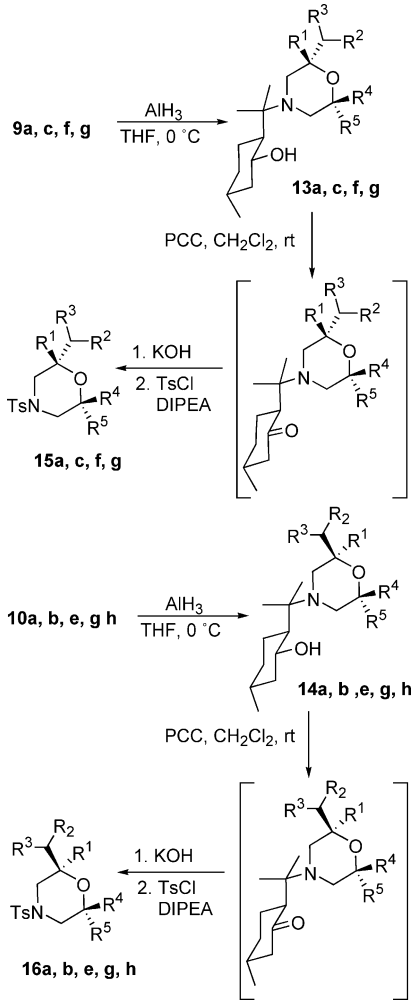
Moreover, treatment of **5d** and **6e** with aluminum hydride in THF provided the aminomenthol derivatives **17** and **18**, respectively, which retain the phenylselenenyl group. After isolation, PCC oxidation in CH_2Cl_2 at room temperature to the aminomenthone derivatives turned out with concomitant oxidation of the selenium substituent and syn elimination of the selonoxide. After β-elimination with KOH in THF−MeOH−H_2O and tosylation, enantiopure morpholines **19** ad **20**, containing a double bond with an allylic stereocenter, were isolated (Scheme 6).

In summary, the described reactions in this paper constitute a general synthetic route to enantiopure morpholines. The stereochemistry of the cyclization products is dependent on both the substitution pattern of the double bond and the experimental conditions. In this way, morpholines of type **5** can be obtained by cyclization of 3-allyl-2-hydroxymethylperhydro-1,3-benzoxazines **4** with PhSeCl in CH_2Cl_2 at −78 °C in the presence of $SnCl_4$. The cyclization of perhydrobenzoxazines **4** with PhSeCl in CH_2Cl_2 at 0 °C in the presence of K_2CO_3 gave diastereomeric

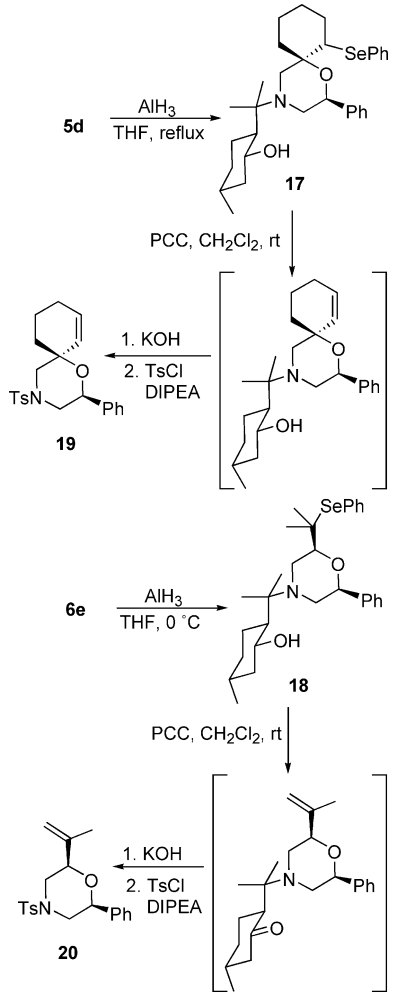
(37) Crystallographic data can be obtained from the Cambridge Crystallographic Data Center, 12 Union Road, Cambridge CB2 1EZ, UK. E-mail: deposit@ccdc.cam.ac.uk.

(38) Pedrosa, R.; Andrés, C.; Nieto, J.; Vicente, M. *J. Org. Chem.* **1998**, *63*, 8570.

SCHEME 5. Transformation of 9a,c,f,g and 10a,b,e,g,h into Morpholines 15a,c,f,g and 16a,b,e,g,h



SCHEME 6. Transformation of 5d and 6e into Morpholines 19 and 20



morpholines of type **6**, although with worse stereoselection. An exception of this behavior is perhydrobenzoxazines with a disubstituted double bond at the terminal position. In these cases, in the described experimental conditions, the reactions yielded the endo (or mixtures of endo and exo) cyclization products **7** and **8** in agreement with Markovnikov's rule. Fortunately, perhydrobenzoxazines with two alkyl groups in the terminal position of the double bond furnished morpholines of type **6** when cyclized with PhSeCl in THF at −78 °C in the presence of 2.5% of MeOH. The cyclohexenyl derivative **4d** and the tertiary alcohol **4f** showed an unexpected behavior and furnished the morpholines **5d** and **5f**, respectively, as major products in all of the conditions examined. This fact is probably due to steric factors because of the endocyclic character of the double bond in **4d** and the increased substitution about the carbinol in **4f**.

Although it is conceivable that the product ratios reflect a thermodynamic or kinetic preference, it is quite unlikely that the reaction is under thermodynamic rather than kinetic control in the tested reaction conditions for several reasons: (i) the very low reaction temperature (−78 °C) for the reactions in the presence of $SnCl_4$ and MeOH, or 0 °C in the presence of a base (K_2CO_3), (ii) once isolated, diastereomers **5a** and **6a** do not interconvert when subjected to the reaction conditions, and (iii) the product ratios do not change with time. For example, the reaction of **4c** with PhSeCl at −78 °C in CH_2Cl_2 in the presence of $SnCl_4$ for 15 min. (ca. 35% conversion) led to **5c** (85%) and **6c** (15%), almost the same ratio of diastereoisomers as that after 2 h (see entry 10 in Table 1).

The same proportion of products was obtained in the reaction of **4c** with PhSeCl at −78 °C in CH_2Cl_2 and $SnCl_4$ for 2 h at −78 °C followed by stirring the reaction mixture for an additional 2 h at −15 °C. However, when the cyclization of **4c** with PhSeCl in CH_2Cl_2 and $SnCl_4$ was carried out at −15 °C, the ratio of the reaction products was substantially different (**5c** (73%):**6c** (27%), 94% of chemical yield).

The selenium electrophile can interact with the internal heteroatoms of the substrate[24,25] and with external additives or the solvent,[17] and, probably, these interactions are responsible for the changes in the stereochemical outcome of the reaction. In the case of the reactions in the presence of $SnCl_4$, it is also possible that the Lewis acid coordinates the nitrogen atom of the substrate. The cyclization on this complex can also explain the modification in the diastereoselection of the process.

Experimental Section

(1*S*,3*R*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-phenylselenenylmethyl-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]-benzoxazine (5a). Colorless solid. Mp: 130−131 °C (from ethanol). $[\alpha]^{25}_D = -43.6$ ($c = 0.8$, CH_2Cl_2). ^{1}H NMR (δ): 0.87−1.00 (m, 3H), 0.89 (d, 3H, $J = 6.4$ Hz), 1.05 (s, 3H), 1.07 (s, 3H), 1.35−1.48 (m, 2H), 1.58−1.70 (m, 2H), 1.87 (m, 1H), 2.71 (dd, 1H, $J_1 = 11.5$ Hz, $J_2 = 3.2$ Hz), 3.12 (dd, 1H, $J_1 = 11.5$ Hz, $J_2 =$

5.2 Hz), 3.25 (dd, 1H, J_1 = 12.3 Hz, J_2 = 5.7 Hz), 3.33 (td, 1H, J_1 = 10.6 Hz, J_2 = 4.1 Hz), 3.38 (dd, 1H, J_1 = 12.3 Hz, J_2 = 8.2 Hz), 3.92 (m, 1H), 4.37 (d, 1H, J = 5.0 Hz), 4.63 (d, 1H, J = 5.0 Hz), 7.17−7.34 (m, 7H), 7.43−7.50 (m, 3H). ^{13}C NMR (δ): 15.5 (CH_3), 22.1 (CH_3), 24.6 (CH_2), 26.3 (CH_3), 29.1 (CH_2), 31.0 (CH), 34.8 (CH_2), 41.2 (CH_2), 44.2 (CH_2), 47.7 (CH), 56.6 (C), 71.5 (CH), 75.0 (CH), 76.8 (CH), 85.1 (CH), 127.1 (CH), 127.8 (CH), 128.0 (2CH), 128.2 (2CH), 129.0 (2CH), 130.1 (C), 133 (2CH), 139.2 (C). IR (Nujol dispersion): 3020, 1580, 750, 730, 690 cm^{-1}. Anal. Calcd for $C_{27}H_{35}NO_2Se$: C, 66.93; H, 7.28; N, 2.89. Found: C, 67.08; H, 7.41; N, 3.02.

(1*S*,3*S*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-phenylselenenylmethyl-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]-benzoxazine (6a). Colorless oil. $[\alpha]^{25}_D$ = +3.9 (c = 1.0, CH_2Cl_2). ^{1}H NMR (δ): 0.82−1.03 (m, 3H), 0.85 (d, 3H, J = 6.5 Hz), 0.88 (s, 3H), 1.13 (s, 3H), 1.24−1.42 (m, 2H), 1.60−1.80 (m, 3H), 2.31 (t, 1H, J = 10.7 Hz), 2.97 (dd, 1H, J_1 = 12.7 Hz, J_2 = 7.5 Hz), 3.06−3.21 (m, 3H), 3.81 (d, 1H, J = 7.7 Hz), 3.96 (m, 1H), 4.27 (d, 1H, J = 7.7 Hz), 7.21−7.32 (m, 6H), 7.38−7.41 (m, 2H), 7.51−7.54 (m, 2H). ^{13}C NMR (δ): 11.4 (CH_3), 22.2 (CH_3), 25.0 (CH_2), 25.6 (CH_3), 30.3 (CH_2), 31.0 (CH), 34.7 (CH_2), 41.0 (CH_2), 47.4 (CH_2), 49.9 (CH), 55.7 (C), 74.2 (CH), 75.8 (CH), 81.1 (CH), 86.4 (CH), 127.0 (CH), 127.6 (3CH), 127.8 (2CH), 129.1 (2CH), 130.1 (C), 132.8 (2CH), 139.2 (C). IR (film): 3020, 1580, 1480, 750, 730, 690 cm^{-1}. Anal. Calcd for $C_{27}H_{35}NO_2Se$: C, 66.93; H, 7.28; N, 2.89. Found: C, 66.80; H, 7.15; N, 3.02.

(1*S*,3*R*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-((*S*)-1-phenylselenenyl-ethy)-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]-benzoxazine (5b). Colorless oil. $[\alpha]^{25}_D$ = −5.4 (c = 1.3, CH_2Cl_2). ^{1}H NMR (δ): 0.85−1.07 (m, 3H), 0.88 (d, 3H, J = 6.5 Hz), 1.05 (s, 3H), 1.07 (s, 3H), 1.30−1.39 (m, 2H), 1.44 (d, 3H, J = 7.0 Hz), 1.57−1.70 (m, 2H), 1.81 (m, 1H), 2.79 (dd, 1H, J_1 = 11.5 Hz, J_2 = 3.1 Hz), 3.31 (td, 1H, J_1 = 10.6 Hz, J_2 = 4.1 Hz), 3.38 (dd, 1H, J_1 = 11.5 Hz, J_2 = 4.9 Hz), 3.65 (ddd, 1H, J_1 = 9.9 Hz, J_2 = 4.9 Hz, J_3 = 3.1 Hz), 3.91 (dq, 1H, J_1 = 9.9 Hz, J_2 = 7.0 Hz), 4.34 (d, 1H, J = 5.3 Hz), 4.49 (d, 1H, J = 5.3 Hz), 7.19−7.34 (m, 6H), 7.36−7.46 (m, 2H), 7.51−7.58 (m, 2H). ^{13}C NMR (δ): 15.2 (CH_3), 18.6 (CH_3), 22.2 (CH_3), 25.0 (CH_2), 26.1 (CH_3), 31.1 (CH), 34.7 (CH_2), 38.9 (CH), 41.0 (CH_2), 43.9 (CH_2), 47.5 (CH), 55.5 (C), 74.9 (CH), 75.3 (CH), 75.7 (CH), 84.8 (CH), 127.6 (CH), 127.7 (CH), 127.9 (2CH), 128.0 (2CH), 128.8 (2CH), 128.9 (C), 135.6 (2CH), 139.2 (C). IR (film): 3020, 740, 690 cm^{-1}. Anal. Calcd for $C_{28}H_{37}NO_2Se$: C, 67.45; H, 7.48; N, 2.81. Found: C, 67.56; H, 7.37; N, 2.94.

(1*S*,3*S*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-((*R*)-1-phenylselenenyl-ethy)-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]-benzoxazine (6b). Colorless solid. Mp: 132−133 °C (from ethanol). $[\alpha]^{25}_D$ = +6.7 (c = 0.8, CH_2Cl_2). ^{1}H NMR (δ): 0.83−1.10 (m, 3H), 0.85 (s, 3H), 0.87 (d, 3H, J = 6.5 Hz), 1.14 (s, 3H), 1.20−1.32 (m, 2H), 1.49 (d, 3H, J = 7.0 Hz), 1.52−1.61 (m, 2H), 1.64 (m, 1H), 2.23 (dd, 1H, J_1 = 11.5 Hz, J_2 = 10.3 Hz), 3.06 (td, 1H, J_1 = 10.6 Hz, J_2 = 4.2 Hz), 3.16 (dd, 1H, J_1 = 11.5 Hz, J_2 = 1.8 Hz), 3.28 (quint, 1H, J = 7.0 Hz), 3.68 (d, 1H, J = 7.7 Hz), 3.71 (m, 1H), 4.20 (d, 1H, J = 7.7 Hz), 7.15−7.38 (m, 6H), 7.36−7.41 (m, 2H), 7.49−7.54 (m, 2H). ^{13}C NMR (δ): 11.4 (CH_3), 18.6 (CH_3), 22.2 (CH_3), 25.0 (CH_2), 25.7 (CH_3), 31.1 (CH), 34.7 (CH_2), 41.0 (CH_2), 41.7 (CH), 46.4 (CH_2), 50.0 (CH), 55.9 (C), 74.2 (CH), 79.7 (CH), 80.8 (CH), 86.5 (CH), 127.5 (CH), 127.6 (2CH), 127.7 (CH), 127.8 (2CH), 129.0 (2CH), 129.1 (C), 135.0 (2CH), 139.5 (C). IR (Nujol dispersion): 3020, 1575, 750, 730, 680 cm^{-1}. Anal. Calcd for $C_{28}H_{37}NO_2Se$: C, 67.45; H, 7.48; N, 2.81. Found: C, 67.58; H, 7.59; N, 2.79.

(1*S*,3*R*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-phenylselenenylmethyl-3,6,6,9-tetramethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]-benzoxazine (5c). Colorless solid. Mp: 119−120 °C (from ethanol). $[\alpha]^{25}_D$ = −2.4 (c = 1.0, CH_2Cl_2). ^{1}H NMR (δ): 0.85−1.08 (m, 3H), 0.87 (d, 3H, J = 6.6 Hz), 0.89 (s, 3H), 1.10 (s, 3H), 1.34 (s, 3H), 1.27−1.35 (m, 2H), 1.58−1.65 (m, 2H), 1.74 (m, 1H), 2.40 (d, 1H, J = 12.0 Hz), 3.12 (d, 1H, J = 12.0 Hz), 3.18 (td, 1H, J_1 = 10.4 Hz, J_2 = 3.9 Hz), 3.57 (d, 1H, J = 11.3 Hz), 3.73 (d, 1H, J = 11.3 Hz), 3.82 (d, 1H, J = 7.7 Hz), 4.59 (d, 1H, J = 7.7 Hz), 7.19−7.27 (m, 6H), 7.31−7.44 (m, 2H), 7.48−7.53 (m, 2H). ^{13}C NMR (δ): 11.6 (CH_3), 22.1 (CH_3), 25.0 (CH_2), 25.8 (CH_3), 26.0 (CH_3), 31.0 (CH), 33.5 (CH_2), 34.6 (CH_2), 40.9 (CH_2), 49.7 (CH), 50.4 (CH_2), 55.2 (C), 73.7 (CH), 74.4 (C), 76.6 (CH), 87.2 (CH), 126.5 (CH), 127.6 (CH), 127.7 (2CH), 128.0 (2CH), 128.9 (2CH), 131.2 (C), 132.4 (2CH), 139.7 (C). IR (Nujol dispersion): 3060, 3020, 1590, 1570, 755, 740, 690 cm^{-1}. Anal. Calcd for $C_{28}H_{37}NO_2Se$: C, 67.45; H, 7.48; N, 2.81. Found: C, 67.40; H, 7.61; N, 2.69.

(1*S*,3*S*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-phenylselenenylmethyl-3,6,6,9-tetramethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]-benzoxazine (6c). Colorless oil. $[\alpha]^{25}_D$ = −18.9 (c = 0.9, CH_2Cl_2). ^{1}H NMR (δ): 0.76−1.19 (m, 3H), 0.78 (s, 3H), 0.85 (d, 3H, J = 6.4 Hz), 1.07 (s, 3H), 1.23−1.69 (m, 4H), 1.57 (s, 3H), 1.77 (m, 1H), 2.50 (d, 1H, J = 11.5 Hz), 2.78 (d, 1H, J = 11.5 Hz), 3.09 (td, 1H, J_1 = 10.5 Hz, J_2 = 4.0 Hz), 3.09 (d, 1H, J = 12.2 Hz), 3.21 (d, 1H, J = 12.2 Hz), 3.22 (d, 1H, J = 8.0 Hz), 4.48 (d, 1H, J = 8.0 Hz), 7.18−7.23 (m, 6H), 7.28−7.36 (m, 2H), 7.49−7.54 (m, 2H). ^{13}C NMR (δ): 11.8 (CH_3), 20.5 (CH_3), 22.2 (CH_3), 25.0 (CH_2), 25.8 (CH_3), 31.0 (CH), 34.6 (CH_2), 39.9 (CH_2), 40.9 (CH_2), 49.6 (CH), 50.6 (CH_2), 55.2 (C), 73.8 (CH), 74.5 (C), 76.2 (CH), 87.5 (CH), 126.7 (CH), 127.5 (CH), 127.6 (2CH), 127.9 (2CH), 128.9 (2CH), 131.6 (C), 132.6 (2CH), 139.9 (C). IR (film): 3060 1595, 1570, 735, 690 cm^{-1}. Anal. Calcd for $C_{28}H_{37}NO_2Se$: C, 67.45; H, 7.48; N, 2.81. Found: C, 67.30; H, 7.61; N, 2.74.

(1*R*,2*S*,1′*S*,6′a*S*,9′*R*,10′a*R*,11′a*S*)-1′-Phenyl-2-phenylselenenyl-6′,6′,9′-trimethyl-decahydro-3′*H*,7′*H*-spiro[cyclohexane-1,3′-[1,4]-oxazino[3,4-*b*][1,3]benzoxazine] (5d). Colorless oil. $[\alpha]^{25}_D$ = −11.3 (c = 0.9, CH_2Cl_2). ^{1}H NMR (δ): 0.85−1.07 (m, 3H), 0.87 (s, 3H), 0.88 (d, 3H, J = 6.5 Hz), 1.12 (s, 3H), 1.24−1.49 (m, 2H), 1.43−1.52 (m, 2H), 1.54−1.70 (m, 5H), 1.73−1.89 (m, 2H), 1.91−2.08 (m, 2H), 2.23 (d, 1H, J = 12.0 Hz), 3.18 (td, 1H, J_1 = 10.6 Hz, J_2 = 4.2 Hz), 3.53 (d, 1H, J = 12.0 Hz), 3.84 (d, 1H, J = 7.8 Hz), 4.46 (d, 1H, J = 7.8 Hz), 4.56 (m, 1H), 7.22−7.34 (m, 6H), 7.43−7.49 (m, 2H), 7.63−7.69 (m, 2H). ^{13}C NMR (δ): 11.7 (CH_3), 20.1 (CH_2), 21.4 (CH_2), 22.1 (CH_3), 24.9 (CH_2), 25.9 (CH_3), 26.5 (CH_2), 31.0 (CH), 33.7 (CH_2), 34.7 (CH_2), 41.1 (CH_2), 46.1 (CH), 50.0 (CH), 51.1 (CH_2), 55.4 (C), 73.9 (CH), 74.0 (CH), 74.6 (C), 87.8 (CH), 126.8 (CH), 127.4 (CH), 127.6 (2CH), 127.8 (2CH), 128.9 (2CH), 131.1 (C), 133.5 (2CH), 140.4 (C). IR (film): 3020, 1590, 760, 740 cm^{-1}. Anal. Calcd for $C_{31}H_{41}NO_2Se$: C, 69.13; H, 7.67; N, 2.60. Found: C, 69.24; H, 7.54; N, 2.4.

(1*S*,2*R*,1′*S*,6′a*S*,9′*R*,10′a*R*,11′a*S*)-1′-Phenyl-2-phenylselenenyl-6′,6′,9′-trimethyl-decahydro-3′*H*,7′*H*-spiro[cyclohexane-1,3′-[1,4]-oxazino[3,4-*b*][1,3]benzoxazine] (6d). Purity 90%. Colorless oil. ^{1}H NMR (δ): 0.82−1.08 (m, 3H), 0.83 (s, 3H), 0.90 (d, 3H, J = 6.5 Hz), 1.15 (s, 3H), 1.28−1.45 (m, 5H), 1.58−1.83 (m, 6H), 2.03 (m, 1H), 2.23 (m, 1H), 2.37 (d, 1H, J = 11.9 Hz), 3.15 (td, 1H, J_1 = 10.5 Hz, J_2 = 4.2 Hz), 3.22 (d, 1H, J = 11.9 Hz), 3.46 (dd, 1H, J_1 = 7.6 Hz, J_2 = 3.9 Hz), 3.77 (d, 1H, J = 7.7 Hz), 4.52 (d, 1H, J = 7.7 Hz), 7.25−7.38 (m, 6H), 7.48−7.56 (m, 2H), 7.63−7.70 (m, 2H). ^{13}C NMR (δ): 11.6 (CH_3), 21.5 (CH_2), 22.1 (CH_3), 24.8 (CH_2), 25.0 (CH_2), 25.9 (CH_3), 28.6 (CH_2), 30.3 (CH_2), 31.0 (CH), 34.6 (CH_2), 41.0 (CH_2), 48.6 (CH_2), 49.7 (CH), 54.0 (CH), 55.2 (C), 73.7 (CH), 75.0 (CH), 75.8 (C), 87.6 (CH), 127.1 (CH), 127.4 (CH), 127.5 (2CH), 128.0 (2CH), 128.9 (2CH), 130.8 (C), 134.4 (2CH), 140.3 (C). IR (film): 3020, 1580, 730 cm^{-1}.

(1*S*,3*S*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-(1-methyl-1-phenylselenenylethy)-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]benzoxazine (6e). Colorless solid. Mp: 170−171 °C (from ethanol). $[\alpha]^{25}_D$ = +8.2 (c = 1.0, CH_2Cl_2). ^{1}H NMR (δ): 0.83−1.12 (m, 3H), 0.89 (d, 3H, J = 6.5 Hz), 0.95 (s, 3H), 1.18−1.43 (m, 2H), 1.22 (s, 3H), 1.42 (s, 3H), 1.47 (s, 3H), 1.54−1.83 (m, 3H), 2.55 (t, 1H, J = 10.8 Hz), 3.18 (dt, 1H, J_1 = 4.0 Hz, J_2 = 10.5 Hz), 3.37 (dd, 1H, J_1 = 10.8 Hz, J_2 = 1.8 Hz), 3.69 (dd, 1H, J_1 = 10.8 Hz, J_2 = 1.8 Hz), 3.77 (d, 1H, J = 7.6 Hz), 4.25 (1H, d, J = 7.6 Hz), 7.23−7.44 (m, 8H), 7.61−7.66 (m, 2H). ^{13}C NMR

(δ): 11.5 (CH_3), 22.0 (CH_3), 25.9 (CH_2), 27.7 (CH_3), 26.1 (CH_3), 27.3 (CH_3), 31.0 (CH), 34.6 (CH_2), 40.9 (CH_2), 43.8 (N−CH_2), 48.5 (C), 50.0 (CH), 55.9 (C), 74.2 (CH), 80.7 (CH), 82.2 (CH), 87.0 (CH), 127.3 (CH), 127.4 (2CH), 127.7 (2CH), 128.5 (CH), 128.6 (2CH), 128.7 (C), 138.4 (2CH), 139.7 (C). IR (Nujol dispersion): 3080, 760, 725, 700 cm^{-1}. Anal. Calcd for $C_{29}H_{39}NO_2Se$: C, 67.95; H, 7.67; N, 2.73. Found: C, 68.07; H, 7.73; N, 2.80.

(1*S*,4*S*,7a*S*,10*R*,11a*R*,12a*S*)-1-Phenyl-4-phenylselenenyl-3,3,7,7,-10-pentamethyl-decahydro-3*H*,7*H*-[1,4]oxazepino[3,4-*b*][1,3]-benzoxazine (7e). Colorless oil. $[\alpha]^{25}_D = +48.0$ ($c = 1.0$, CH_2Cl_2). ^1H NMR (δ): 0.65 (s, 3H), 0.73−1.01 (m, 3H), 0.87 (d, 3H, J = 6.4 Hz), 1.04 (s, 3H), 1.13 (m, 1H), 1.22−1.48 (m, 2H), 1.30 (s, 3H), 1.62 (m, 1H), 1.65 (s, 3H), 1.80 (m, 1H), 3.03 (dd, 1H, J_1 = 14.5 Hz, J_2 = 1.6 Hz), 3.31 (td, 1H, J_1 = 10.6 Hz, J_2 = 3.9 Hz), 3.39 (dd, 1H, J_1 = 10.9 Hz, J_2 = 1.6 Hz), 3.52 (dd, 1H, J_1 = 14.5 Hz, J_2 = 10.9 Hz), 4.59 (d, 1H, J = 7.5 Hz), 4.66 (d, 1H, J = 7.5 Hz), 7.19−7.32 (m, 6H), 7.48−7.52 (m, 2H), 7.63−7.69 (m, 2H). ^{13}C NMR (δ): 20.9 (CH_3), 21.1 (CH_3), 22.3 (CH_3), 24.9 (CH_2), 26.9 (CH_3), 30.9 (CH_3), 31.2 (CH), 34.9 (CH_2), 41.4 (CH_2), 44.3 (CH_2), 47.1 (CH), 57.0 (C), 59.5 (CH), 74.4 (CH), 75.1 (CH), 78.3 (C), 89.4 (CH), 126.4 (2CH), 126.8 (CH), 127.6 (CH), 127.8 (2CH), 129.0 (2CH), 129.9 (C), 135.1 (2CH), 142.7 (C). IR (film): 3040, 3020, 1610, 740, 690 cm^{-1}. Anal. Calcd for $C_{29}H_{39}NO_2Se$: C, 67.95; H, 7.67; N, 2.73. Found: C, 67.86; H, 7.78; N, 2.70.

(1*S*,3*R*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-(1-methyl-1-phenylselenenylethy)-1,6,6,9-tetramethyl-decahydro-3*H*,7*H*-[1,4]oxazino-[3,4-*b*][1,3]benzoxazine (5f). Colorless oil. $[\alpha]^{25}_D = -97.2$ (c = 1.3, CH_2Cl_2). ^1H NMR (δ): 0.85−1.35 (m, 4H), 0.95 (d, 3H, J = 6.4 Hz), 1.06 (s, 3H), 1.32 (s, 3H), 1.35 (s, 3H), 1.36 (s, 3H), 1.38 (s, 3H), 1.44−1.64 (m, 2H), 1.70 (m, 1H), 2.01 (m, 1H), 2.72 (dd, 1H, J_1 = 10.3 Hz, J_2 = 2.3 Hz), 3.17 (t, 1H, J = 10.3 Hz), 3.42 (dd, 1H, J_1 = 10.3 Hz, J_2 = 2.3 Hz), 3.57 (td, 1H, J_1 = 10.6 Hz, J_2 = 3.9 Hz), 5.1 (s, 1H), 7.17−7.33 (m, 6H), 7.41−7.45 (m, 2H), 7.58−7.65 (m, 2H). ^{13}C NMR (δ): 21.5 (CH_3), 22.4 (CH_3), 25.2 (CH_2), 26.6 (CH_3), 26.8 ($2CH_3$), 29.0 (CH_3), 31.5 (CH), 35.1 (CH_2), 40.4 (CH_2), 41.3 (CH_2), 43.5 (CH), 49.4 (C), 56.4 (C), 77.1 (2CH), 77.8 (C), 82.4 (CH), 126.2 (2CH), 126.4 (CH), 128.0 (C), 128.1 (C), 128.2 (2CH), 128.3 (2CH), 132.7 (2CH), 145.3 (C). IR (film): 3040, 1590, 1440, 1350, 730, 690 cm^{-1}. Anal. Calcd for $C_{30}H_{41}NO_2Se$: C, 68.42; H, 7.85; N, 2.66. Found: C, 68.51; H, 7.72; N, 2.79.

(1*S*,3*S*,6a*S*,9*R*,10a*R*,11a*S*)-1-Phenyl-3-(1-methyl-1-phenylselenenylethy)-1,6,6,9-tetramethyl-decahydro-3*H*,7*H*-[1,4]oxazino-[3,4-*b*][1,3]benzoxazine (6f). Colorless solid. Mp: 184−185 °C (from ethanol). $[\alpha]^{25}_D = -8.2$ (c = 0.5, CH_2Cl_2). ^1H NMR (δ): 0.84−1.13 (m, 3H), 0.85 (s, 3H), 0.91 (d, 3H, J = 6.5 Hz), 1.16 (s, 3H), 1.21−1.38 (m, 2H), 1.41 (s, 3H), 1.44 (s, 3H), 1.56 (s, 3H), 1.58−1.70 (m, 2H), 1.85 (m, 1H), 2.38 (t, 1H, J = 10.6 Hz), 3.16 (td, 1H, J_1 = 10.4 Hz, J_2 = 4.1 Hz), 3.23 (dd, 1H, J_1 = 10.6 Hz, J_2 = 2.1 Hz), 3.76 (s, 1H), 3.89 (dd, 1H, J_1 = 10.6 Hz, J_2 = 2.1 Hz), 7.20−7.39 (6H, m), 7.59−7.68 (m, 4H). ^{13}C NMR (δ): 11.4 (CH_3), 18.2 (CH_3), 22.2 (CH_3), 24.9 (CH_2), 26.0 (CH_3), 26.1 (CH_3), 27.2 (CH_3), 30.9 (CH), 34.6 (CH_2), 41.2 (CH_2), 44.5 (CH_2), 49.0 (C), 49.6 (CH), 55.6 (C), 73.2 (CH), 75.9 (CH), 76.9 (C), 88.7 (CH), 126.5 (3CH), 127.3 (2CH), 127.4 (C), 128.4 (CH), 128.5 (2CH), 138.5 (2CH), 146.4 (C). IR (Nujol dispersion): 3040, 1590, 1440, 1350, 730, 690 cm^{-1}. Anal. Calcd for $C_{30}H_{41}NO_2Se$: C, 68.42; H, 7.85; N, 2.66. Found: C, 68.54; H, 7.99; N, 2.75.

(3*R*,6a*S*,9*R*,10a*R*,11a*S*)-3-Phenylselenenylmethyl-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]benzoxazine (5g). Colorless oil. $[\alpha]^{25}_D = -21.12$ (c = 1.0, CH_2Cl_2). ^1H NMR (δ): 0.84−1.20 (m, 3H), 0.92 (d, 3H, J = 6.5 Hz), 1.05 (s, 3H), 1.16 (s, 3H), 1.38−1.58 (m, 3H), 1.69 (m, 1H), 1.93 (m, 1H), 2.81 (dd, 1H, J_1 = 10.8 Hz, J_2 = 4.0 Hz), 2.85 (t, 1H, J = 10.8 Hz), 2.94 (dd, 1H, J_1 = 12.6 Hz, J_2 = 6.7 Hz), 3.13 (dd, 1H, J_1 = 12.6 Hz, J_2 = 6.5 Hz), 3.48 (td, 1H, J_1 = 10.6 Hz, J_2 = 4.1 Hz), 3.61 (dd, 1H, J_1 = 11.9 Hz, J_2 = 1.9 Hz), 3.70 (dddd, 1H, J_1 = 10.8 Hz, J_2 = 6.7 Hz, J_3 = 6.5 Hz, J_4 = 4.0 Hz), 3.90 (dd, 1H, J_1 = 11.9 Hz, J_2 = 1.9 Hz), 4.48 (t, 1H, J = 1.9 Hz), 7.22−7.30 (m, 3H), 7.48−7.53 (m, 2H). ^{13}C NMR (δ): 20.9 (CH_3), 22.2 (CH_3), 25.0 (CH_2), 26.2 (CH_3), 30.4 (CH_2), 31.3 (CH), 34.9 (CH_2–SePh), 41.2 (CH_2), 43.4 (CH), 45.1 (CH_2), 55.8 (C), 70.0 (CH_2), 75.8 (CH), 76.1 (CH), 79.7 (CH), 126.9 (CH), 129.0 (2CH), 130.2 (C), 132.6 (2CH). IR (film): 3040, 3020, 1580, 745, 680, 650 cm^{-1}. Anal. Calcd for $C_{21}H_{31}NO_2Se$: C, 61.75; H, 7.65; N, 3.43. Found: C, 61.87; H, 7.77; N, 3.54.

(3*S*,6a*S*,9*R*,10a*R*,11a*S*)-3-Phenylselenenylmethyl-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]benzoxazine (6g). Colorless oil. $[\alpha]^{25}_D = +1.7$ (c = 1.0, CH_2Cl_2). ^1H NMR (δ): 0.80−1.18 (m, 3H), 0.87 (s, 3H), 0.89 (d, 3H, J = 6.6 Hz), 1.06 (s, 3H), 1.30 (m, 1H), 1.40 (m, 1H), 1.62−1.68 (m, 2H), 1.89 (m, 1H), 2.11 (dd, 1H, J_1 = 11.6 Hz, J_2 = 9.9 Hz), 2.87 (dd, 1H, J_1 = 12.5 Hz, J_2 = 6.4 Hz), 3.01 (dd, 1H, J_1 =12.5 Hz, J_2 = 3.7 Hz), 3.03 (dd, 1H, J_1 = 11.6 Hz, J_2 = 2.2 Hz), 3.29 (dd, 1H, J_1 = 10.9 Hz, J_2 = 8.7 Hz), 3.35 (td, 1H, J_1 = 10.6 Hz, J_2 = 4.2 Hz), 3.73 (dddd, 1H, J_1 = 9.9 Hz, J_2 = 6.4 Hz, J_3 = 3.7 Hz, J_4 = 2.2 Hz), 3.86 (dd, 1H, J_1 = 10.9 Hz, J_2 = 3.7 Hz), 4.06 (dd, 1H, J_1 = 8.7 Hz, J_2 = 3.7 Hz), 7.20−7.28 (m, 3H), 7.49−7.54 (m, 2H). ^{13}C NMR (δ): 11.4 (CH_3), 22.1 (CH_3), 24.9 (CH_2), 25.2 (CH_3), 30.2 (CH_2), 31.0 (CH), 34.5 (CH_2), 41.1 (CH_2), 47.1 (CH_2), 49.9 (CH), 55.3 (C), 69.7 (CH_2), 74.4 (CH), 75.8 (CH), 81.2 (CH), 127.1 (CH), 129.0 (2CH), 129.8 (C), 132.9 (2CH). IR (film): 3040, 3050, 1580, 750, 730, 680 cm^{-1}. Anal. Calcd for $C_{21}H_{31}NO_2Se$: C, 61.75; H, 7.65; N, 3.43. Found: C, 61.64; H, 7.76; N, 3.50.

(3*R*,6a*S*,9*R*,10a*R*,11a*S*)-3-(1-Methyl-1-phenylselenenylethy)-6,6,9-trimethyl-decahydro-3*H*,7*H*-[1,4]oxazino[3,4-*b*][1,3]-benzoxazine (5h). Colorless oil. $[\alpha]^{25}_D = -29.5$ (c = 0.5, CH_2Cl_2). ^1H NMR (δ): 0.78−1.04 (m, 2H), 0.92 (d, 3H, J = 6.5 Hz), 1.10 (s, 3H), 1.09 (m, 1H), 1.20 (s, 3H), 1.37 (s, 3H), 1.38−1.59 (m, 3H), 1.41 (s, 3H), 1.69 (m, 1H), 1.91 (m, 1H), 2.92 (dd, 1H, J_1 = 10.4 Hz, J_2 = 2.3 Hz), 3.04 (t, 1H, J = 10.4 Hz), 3.40 (dd, 1H, J_1 = 10.4 Hz, J_2 = 2.3 Hz), 3.49 (td, 1H, J_1 = 10.4 Hz, J_2 = 4.1 Hz), 3.57 (dd, 1H, J_1 = 11.8 Hz, J_2 = 1.9 Hz), 3.94 (dd, 1H, J_1 = 11.8 Hz, J_2 = 1.0 Hz), 4.50 (dd, 1H, J_1 = 1.9 Hz, J_2 = 1.0 Hz), 7.21−7.38 (m, 3H), 7.61−7.67 (m, 2H). ^{13}C NMR (δ): 21.5 (CH_3), 22.2 (CH_3), 25.1 (CH_2), 26.0 (CH_3), 26.4 (CH_3), 26.6 (CH_3), 31.3 (CH), 34.9 (CH_2), 40.9 (CH_2), 41.2 (CH_2), 43.1 (CH), 48.8 (C), 55.9 (C), 70.4 (CH_2), 76.0 (CH), 79.5 (CH), 82.8 (CH), 127.4 (CH), 128.5 (3CH), 138.5 (2CH). IR (film): 3040, 1585, 740, 695, 670 cm^{-1}. Anal. Calcd for $C_{23}H_{35}NO_2Se$: C, 63.29; H, 8.08; N, 3.21. Found: C, 63.38; H, 8.21; N, 3.12.

(4*S*,7a*S*,10*R*,11a*R*,12a*S*)-3,3,7,7,10-Pentamethyl-4-phenylselenenyl-decahydro-3*H*,7*H*-[1,4]oxazepino[3,4-*b*][1,3]-benzoxazine (7h). Colorless oil. $[\alpha]^{25}_D = +68.9$ (c = 0.6, CH_2Cl_2). ^1H NMR (δ): 0.78 (s, 3H), 0.80−0.95 (m, 2H), 0.89 (d, 3H, J = 6.5 Hz), 1.03 (s, 3H), 1.05 (m, 1H), 1.24 (m, 1H), 1.27 (s, 3H), 1.41 (m, 1H), 1.43 (s, 3H), 1.50 (m, 1H), 1.66 (m, 1H), 1.89 (m, 1H), 2.98 (d, 1H, J = 13.0 Hz), 3.41 (td, 1H, J_1 = 10.3 Hz, J_2 = 4.0 Hz), 3.43 (d, 1H, J = 9.0 Hz), 3.51 (dd, 1H, J_1 = 13.0 Hz, J_2 = 9.0 Hz), 3.68−3.71 (m, 2H), 4.56 (t, 1H, J = 3.9 Hz), 7.19−7.26 (m, 3H), 7.56−7.61 (m, 2H). ^{13}C NMR (δ): 19.8 (CH_3), 22.2 (CH_3), 24.7 (CH_3), 25.0 (CH_2), 27.0 (CH_3), 27.4 (CH_3), 31.2 (CH), 34.8 (CH_2), 41.3 (CH_2), 44.3 (CH_2), 46.6 (CH), 56.7 (C), 57.5 (CH), 64.9 (CH_2), 75.5 (CH), 77.2 (C), 83.4 (CH), 127.2 (CH), 128.9 (2CH), 130.9 (C), 134.0 (2CH). IR (film): 3040, 1580, 735, 690, 675 cm^{-1}. Anal. Calcd for $C_{23}H_{35}NO_2Se$: C, 63.29; H, 8.08; N, 3.21. Found: C, 63.41; H, 7.97; N, 3.35.

(4*R*,7a*S*,10*R*,11a*R*,12a*S*)-3,3,7,7,10-Pentamethyl-4-phenylselenenyl-decahydro-3*H*,7*H*-[1,4]oxazepino[3,4-*b*][1,3]-benzoxazine (8h). Colorless oil. ^1H NMR (δ): 0.68 (s, 3H, CH_3), 0.74−0.92 (m, 2H), 0.84 (s, 3H), 0.88 (d, 3H, J = 6.5 Hz), 0.97 (m, 1H), 1.13 (m, 1H), 1.23 (s, 3H), 1.39 (m, 1H), 1.48 (s, 3H), 1.53−1.64 (m, 2H), 1.87 (m, 1H), 2.83 (dd, 1H, J_1 = 13.8 Hz, J_2 = 8.8 Hz), 3.09 (d, 1H, J = 13.8 Hz), 3.29 (td, 1H, J_1 = 10.6 Hz, J_2 = 4.2 Hz), 3.56−3.59 (m, 3H), 4.05 (t, 1H, J = 5.5 Hz), 7.22−7.29 (m, 3H), 7.56−7.65 (m, 2H). ^{13}C NMR (δ): 12.2 (CH_3), 22.0 (CH_3), 24.9 (CH_2), 25.1 (CH_3), 25.3 (CH_3), 25.6 (CH_3), 30.8 (CH),

34.4 (CH_2), 40.9 (CH_2), 46.1 (CH_2), 49.6 (CH), 55.4 (CH), 56.9 (C), 65.7 (CH_2), 75.0 (CH), 76.7 (C), 85.5 (CH), 127.3 (CH), 128.8 (2CH), 129.6 (C), 134.3 (2CH). IR (film): 3040, 1580, 730, 695, 670, 645 cm^{-1}. Anal. Calcd for $C_{23}H_{35}NO_2Se$: C, 63.29; H, 8.08; N, 3.21. Found: C, 63.32; H, 8.20; N, 3.33.

(2*S*,6*S*)-6-Methyl-2-phenyl-4-tosyl-morpholine (15a).[40] Yield: 57%. Colorless solid. Mp: 136−137 °C (from hexane). $[\alpha]^{25}_D$ = +52.7 (c = 1.1, CH_2Cl_2). ^1H NMR (δ): 1.33 (d, 3H, J = 6.5 Hz), 2.43 (s, 3H), 2.88 (dd, 1H, J_1 = 11.4 Hz, J_2 = 5.2 Hz), 2.97 (dd, 1H, J_1 = 11.4 Hz, J_2 = 3.2 Hz), 3.05 (dd, 1H, J_1 = 11.4 Hz, J_2 = 6.3 Hz), 3.30 (dd, 1H, J_1 = 11.4 Hz, J_2 = 3.2 Hz), 4.03 (m, 1H), 4.94 (dd, 1H, J_1 = 6.3 Hz, J_2 = 3.2 Hz), 7.22−7.44 (m, 7H), 7.62 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 17.1 (CH_3), 21.5 (CH_3), 49.4 (CH_2), 50.2 (CH_2), 66.6 (CH), 70.7 (CH), 126.8 (2CH), 127.7 (2CH), 127.9 (CH), 128.4 (2CH), 129.7 (2CH), 131.9 (C), 138.5 (C), 143.8 (C). IR (Nujol): 1595, 810, 780, 735, 710, 695, 690 cm^{-1}. Anal. Calcd for $C_{18}H_{21}NO_3S$: C, 65.23; H, 6.39; N, 4.23. Found: C, 65.09; H, 6.50; N, 4.18.

(2*S*)-6,6-Dimethyl-2-phenyl-4-tosyl-morpholine (15c). Yield: 62%. Colorless solid. Mp: 151−152 °C (from hexane). $[\alpha]^{25}_D$ = +20.0 (c = 0.8, CH_2Cl_2). ^1H NMR (δ): 1.27 (s, 3H), 1.49 (s, 3H), 2.04 (dd, 1H, J_1 = 11.1 Hz, J_2 = 10.7 Hz), 2.15 (d, 1H, J = 11.1 Hz), 2.42 (s, 3H), 3.47 (dd, 1H, J_1 = 11.1 Hz, J_2 = 1.8 Hz), 3.75 (ddd, 1H, J_1 = 11.1 Hz, J_2 = 2.8 Hz, J_3 = 1.8 Hz), 4.90 (dd, 1H, J_1 = 10.7 Hz, J_2 = 2.8 Hz), 7.26−7.32 (m, 7H), 7.58 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 21.6 (CH_3), 21.7 (CH_3), 27.8 (CH_3), 51.9 (CH_2), 54.2 (CH_2), 71.2 (CH), 71.8 (C), 126.2 (2CH), 127.6 (2CH), 128.1 (CH), 128.4 (2CH), 129.7 (2CH), 132.5 (C), 139.5 (C), 143.8 (C). IR (Nujol): 1590, 700, 660 cm^{-1}. Anal. Calcd for $C_{19}H_{23}NO_3S$: C, 66.06; H, 6.71; N, 4.05. Found: C, 66.16; H, 6.59; N, 3.92.

(2*S*,6*S*)-6-Isopropyl-2-methyl-2-phenyl-4-tosyl-morpholine (15f). Yield: 67%. Colorless solid. Mp: 172−173 °C (from hexane). $[\alpha]^{25}_D$ = −100.4 (c = 1.5, CH_2Cl_2). ^1H NMR (δ): 0.81 (d, 3H, J = 6.8 Hz), 0.95 (d, 3H, J = 6.8 Hz), 1.33 (s, 3H), 1.57 (oct, 1H, J = 6.8 Hz), 2.03 (t, 1H, J = 10.7 Hz), 2.26 (d, 1H, J = 12.0 Hz), 2.42 (s, 3H), 3.14 (ddd, 1H, J_1 = 10.7 Hz, J_2 = 6.8 Hz, J_3 = 2.4 Hz), 3.50 (ddd, 1H, J_1 = 10.7 Hz, J_2 = 2.4 Hz, J_3 = 1.0 Hz), 4.36 (dd, 1H, J_1 = 12.0 Hz, J_2 = 1.0 Hz), 7.26 (m, 1H), 7.30−7.43 (m, 4H), 7.49 (m, 2H), 7.63 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 18.2 (CH_3), 18.3 (CH_3), 21.4 (CH_3), 30.4 (CH_3), 31.1 (CH), 48.0 (CH_2), 51.0 (CH_2), 73.9 (CH), 75.0 (C), 126.4 (2CH), 126.9 (CH), 127.6 (2CH), 128.3 (2CH), 129.6 (2CH), 131.9 (C), 142.4 (C), 143.6 (C). IR (Nujol): 3050, 3030, 1595, 815, 800, 770, 705, 660, 620 cm^{-1}. Anal. Calcd for $C_{21}H_{27}NO_3S$: C, 67.53; H, 7.29; N, 3.75. Found: C, 67.69; H, 7.20; N, 3.86.

(2*S*)-2-Methyl-4-tosyl-morpholine (15g). Yield: 62%. Colorless solid. Mp: 77−78 °C (from hexane). $[\alpha]^{25}_D$ = + 31.7 (c = 0.8, CH_2Cl_2). ^1H NMR (δ): 1.13 (d, 3H, J = 6.2 Hz), 2.01 (dd, 1H, J_1 = 11.4 Hz, J_2 = 10.2 Hz), 2.37 (td, 1H, J_1 = 11.6 Hz, J_2 = 3.4 Hz), 2.45 (s, 3H), 3.48−3.59 (m, 2H), 3.60−3.72 (m, 2H), 3.88 (ddd, 1H, J_1 = 11.6 Hz, J_2 = 3.4 Hz, J_3 = 1.4 Hz), 7.35 (d, 2H, J = 8.2 Hz), 7.64 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 18.6 (CH_3), 21.5 (CH_3), 45.2 (CH_2), 51.5 (CH_2), 65.9 (CH_2), 71.4 (CH), 127.8 (2CH), 129.7 (2CH), 132.0 (C), 143.9 (C). IR (Nujol): 3025, 1595, 820, 760, 710, 660 cm^{-1}. Anal. Calcd for $C_{12}H_{17}NO_3S$: C, 56.45; H, 6.71; N, 5.49. Found: C, 56.30; H, 6.82; N, 5.39.

(2*S*,6*R*)-6-Methyl-2-phenyl-4-tosyl-morpholine (16a). Yield: 60%. Colorless solid. Mp: 109−110 °C (from hexane). $[\alpha]^{25}_D$ = +67.8 (c = 1.2, CH_2Cl_2). ^1H NMR (δ): 1.23 (d, 3H, J = 6.2 Hz), 2.06 (dd, 1H, J_1 = 11.1 Hz, J_2 = 10.5 Hz), 2.15 (dd, 1H, J_1 = 11.1 Hz, J_2 = 10.5 Hz), 2.43 (s, 3H), 3.66 (ddd, 1H, J_1 = 11.1 Hz, J_2 = 2.5 Hz, J_3 = 1.9 Hz), 3.76 (ddd, 1H, J_1 = 11.1 Hz, J_2 = 2.5 Hz, J_3 = 1.9 Hz), 3.89 (dqd, 1H, J_1 = 10.5 Hz, J_2 = 6.2 Hz, J_3 = 2.5 Hz), 4.65 (dd, 1H, J_1 = 10.5 Hz, J_2 = 2.5 Hz), 7.26−7.38 (m, 7H), 7.61 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 18.7 (CH_3), 21.5 (CH_3), 50.9 (CH_2), 51.3 (CH_2), 71.7 (CH), 77.3 (CH), 126.0 (2CH), 127.7 (2CH), 128.2 (CH), 128.4 (2CH), 129.7 (2CH), 132.2 (C), 138.7 (C), 143.8 (C). IR (Nujol): 320, 340, 1590, 800, 780, 745, 690, 665 cm^{-1}. Anal. Calcd for $C_{18}H_{21}NO_3S$: C, 65.23; H, 6.39; N, 4.23. Found: C, 65.38; H, 6.30; N, 4.35.

(2*S*,6*R*)-6-Ethyl-2-Phenyl-4-tosyl-morpholine (16b). Yield: 65%. Colorless solid. Mp: 143−144 °C (from hexane). $[\alpha]^{25}_D$ = +147.8 (c = 0.7, CH_2Cl_2). ^1H NMR (δ): 0.98 (t, 3H, J = 7.5 Hz), 1.48−1.67 (m, 2H), 2.06 (t, 1H, J = 11.2 Hz), 2.13 (dd, 1H, J_1 = 11.0 Hz, J_2 = 10.5 Hz), 2.42 (s, 3H), 2.65 (m, 1H), 3.67 (ddd, 1H, J_1 = 11.0 Hz, J_2 = 2.4 Hz, J_3 = 1.9 Hz), 3.78 (ddd, 1H, J_1 = 11.2 Hz, J_2 = 2.4 Hz, J_3 = 1.9 Hz), 4.64 (dd, 1H, J_1 = 10.5 Hz, J_2 = 2.3 Hz), 7.22−7.39 (m, 7H), 7.61 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 9.6 (CH_3), 21.5 (CH_3), 26.3 (CH_2), 49.5 (CH_2), 51.6 (CH_2), 76.7 (CH), 77.1 (CH), 125.9 (2CH), 127.7 (2CH), 128.1 (CH), 128.4 (2CH), 129.7 (2CH), 132.2 (C), 138.9 (C), 143.8 (C). IR (Nujol): 1590, 810, 790, 695, 660 cm^{-1}. Anal. Calcd for $C_{19}H_{23}NO_3S$: C, 66.06; H, 6.71; N, 4.05. Found: C, 66.15; H, 6.60; N, 3.96.

(2*S*,6*R*)-6-Isopropyl-2-phenyl-4-tosyl-morpholine (16e). Yield: 61%. Colorless solid. Mp: 101−102 °C (from hexane). $[\alpha]^{25}_D$ = +129.7 (c = 0.5, CH_2Cl_2). ^1H NMR (δ): 0.95 (d, 3H, J = 6.8 Hz), 0.98 (d, 3H, J = 6.8 Hz), 1.77 (oct, 1H, J = 6.8 Hz), 2.09 (dd, 1H, J_1 = 11.1 Hz, J_2 = 10.5 Hz), 2.11 (dd, 1H, J_1 = 11.1 Hz, J_2 = 10.5 Hz), 2.42 (s, 3H), 3.47 (ddd, 1H, J_1 = 10.5 Hz, J_2 = 6.8 Hz, J_3 = 2.5 Hz), 3.71 (ddd, 1H, J_1 = 11.1 Hz, J_2 = 2.5 Hz, J_3 = 1.7 Hz), 3.78 (ddd, 1H, J_1 = 11.1 Hz, J_2 = 2.5 Hz, J_3 = 1.7 Hz), 4.62 (dd, 1H, J_1 = 10.5 Hz, J_2 = 2.5 Hz), 7.22−7.37 (m, 7H), 7.60 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 18.4 ($2CH_3$), 21.5 (CH_3), 31.3 (CH), 47.5 (CH_2), 51.6 (CH_2), 76.8 (CH), 80.1 (CH), 125.8 (2CH), 127.7 (2CH), 127.9 (CH), 128.3 (2CH), 129.7 (2CH), 132.0 (C), 139 (C), 143.8 (C). IR (Nujol): 3040, 3020,1585, 795, 760, 740 695, 650 cm^{-1}. Anal. Calcd for $C_{20}H_{25}NO_3S$: C, 66.82; H, 7.01; N, 3.90. Found: C, 66.70; H, 6.92; N, 4.02.

(2*R*)-2-Methyl-4-tosyl-morpholine (16g). Yield: 58%. Colorless solid. $[\alpha]^{25}_D$ = −29.1 (c = 0.5, CH_2Cl_2). ^1H NMR, ^{13}C NMR, and IR data are coincident with those reported for **15g**. Anal. Calcd for $C_{12}H_{17}NO_3S$: C, 56.45; H, 6.71; N, 5.49. Found: C, 56.57; H, 6.68; N, 5.61.

(2*R*)-2-Isopropyl-4-tosyl-morpholine (16h). Yield: 46%. Colorless oil. $[\alpha]^{25}_D$ = −35.1 (c = 0.3, CH_2Cl_2). ^1H NMR (δ): 0.89 (d, 3H, J = 6.8 Hz), 0.92 (d, 3H, J = 6.8 Hz), 1.64 (oct, 1H, J = 6.8 Hz), 2.07 (dd, 1H, J_1 = 10.0 Hz, J_2 = 10.8 Hz), 2.37 (td, 1H, J_1 = 11.5 Hz, J_2 = 3.4 Hz), 2.45 (s, 3H), 3.20 (ddd, 1H, J_1 = 10.0 Hz, J_2 = 6.8 Hz, J_3 = 2.4 Hz), 3.50 (m, 1H), 3.62 (m, 1H), 3.64 (td, 1H, J_1 = 11.5 Hz, J_2 = 2.7 Hz), 3.90 (ddd, 1H, J_1 = 11.5 Hz, J_2 = 3.4 Hz, J_3 = 1.4 Hz), 7.35 (d, 2H, J = 8.2 Hz), 7.64 (d, 2H, J = 8.2 Hz). ^{13}C NMR (δ): 18.3 (CH_3), 18.4 (CH_3), 21.5 (CH_3), 31.1 (CH), 45.5 (CH_2), 48.2 (CH_2), 65.9 (CH_2), 80.2 (CH), 127.8 (2CH), 129.7 (2CH), 132.1 (C), 143.8 (C). IR (film): 3050, 2925, 2850, 1595, 815, 750, 655, 610 cm^{-1}. Anal. Calcd for $C_{14}H_{21}NO_3S$: C, 59.34; H, 7.47; N, 4.94. Found: C, 59.50; H, 7.58; N, 5.07.

(3*S*,6*S*′)-6′-Phenyl-spiro[cyclohexene-3,2′-morpholine] (19). Yield: 27%. Colorless oil. $[\alpha]^{25}_D$ = +62.5 (c = 0.3, CH_2Cl_2). ^1H NMR (δ): 1.35−2.09 (m, 6H), 2.11 (dd, 1H, J_1 = 11.2 Hz, J_2 = 10.7 Hz), 2.24 (d, 1H, J = 11.2 Hz), 2.42 (s, 3H), 3.51 (dd, 1H, J_1 = 11.2 Hz, J_2 = 1.7 Hz), 3.84 (ddd, 1H, J_1 = 11.2 Hz, J_2 = 2.8 Hz, J_3 = 1.7 Hz), 4.97 (dd, 1H, J_1 = 11.2 Hz, J_2 = 2.8 Hz), 5.98 (ddd, 1H, J_1 =10.3 Hz, J_2 = 4.4 Hz, J_3 = 2.9 Hz), 6.47 (d, 1H, J = 10.3 Hz), 7.19−7.33 (m, 7H), 7.6 (d, 2H, J = 8.3 Hz). ^{13}C NMR (δ): 17.5 (CH_2), 21.5 (CH_3), 25.9 (CH_2), 34.3 (CH_2), 52.2 (CH_2), 54.0 (CH_2), 69.4 (C), 70.5 (CH), 125.3 (CH), 126.0 (2CH), 127.7 (2CH), 127.9 (CH), 128.3 (2CH), 129.7 (2CH), 132.4 (C), 132.7 (CH), 139.5 (C), 143.8 (C). IR (film): 3060, 3030, 1640, 1595,

(39) The 1-(bromomethyl)cyclohexene was prepared by reduction of methyl cyclohexene-1-carboxylate to the alcohol with $LiAlH_4$ and bromination with CBr_4–PPh_3 in CH_2Cl_2. Kocienski, P. J.; Cernigliaro, G.; Feldstein, G. *J. Org. Chem.* **1977**, *42*, 353.

(40) The detosylated morpholine **15a** has been previously described: Bouron, E.; Goussard, G.; Marchand, C.; Bonin, M.; Pannecoucke, X.; Quiron, J.-C.; Husson, H.-P. *Tetrahedron Lett.* **1999**, *40*, 7227.

1455, 810, 785, 740, 710, 700, 665 cm^{-1}. Anal. Calcd for $C_{22}H_{25}NO_3S$: C, 68.90; H, 6.57; N, 3.65. Found: C, 69.02; H, 6.48; N, 3.79.

(2*S*,6*R*)-2-Phenyl-6-(propen-2-yl)-4-tosyl-morpholine (20). Yield: 56%. Colorless solid. Mp: 166−165 °C (from hexane). $[\alpha]^{25}_D = +47.7$ ($c = 0.7$, CH_2Cl_2). ^1H NMR (δ): 1.80 (s, 3H), 2.15 (dd, 1H, $J_1 = 11.3$ Hz, $J_2 = 10.5$ Hz), 2.17 (dd, 1H, $J_1 = 11.3$ Hz, $J_2 = 10.5$ Hz), 2.42 (s, 3H), 3.76−3.82 (m, 2H), 4.19 (dd, 1H, $J_1 = 10.5$ Hz, $J_2 = 2.2$ Hz), 4.71 (dd, 1H, $J_1 = 10.5$ Hz, $J_2 = 2.4$ Hz), 4.95 (s, 1H), 5.11 (s, 1H), 7.26−7.35 (m, 7H), 7.60 (d, 2H, $J = 8.2$ Hz). ^{13}C NMR (δ): 19.2 (CH_3), 21.6 (CH_3), 49.0 (CH_2), 51.7 (CH_2), 77.0 (CH), 78.3 (CH), 112.8 (CH_2), 126.0 (2CH), 127.8 (2CH), 128.2 (CH), 128.5 (2CH), 129.8 (2CH), 132.4 (C), 138.8 (C), 142.0 (C), 144.0 (C). IR (Nujol): 3350 (broad), 3020, 1645, 1595, 805, 775, 760, 700, 660 cm^{-1}. Anal. Calcd for $C_{20}H_{23}NO_3S$: C, 67.20; H, 6.49; N, 3.92. Found: C, 67.34; H, 6.62; N, 4.01.

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Supporting Information Available: General experimental methods and physical and spectral characteristics for compounds **3d**, **4a**−**f**, **9a**−**h**, **10a**−**h**, **11c**−**h**, **12**, **13a**−**g**, **14a**−**h**, **17**, and **18**. This material is available free of charge via the Internet at http://pubs.acs.org.

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