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Supporting Information

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$PtCl_4$ Catalysed Domino Synthesis of New Fused Bicyclic Acetals

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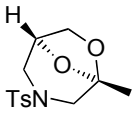
All solvents and chemicals were used as provided by the supplier, or were dried and purified according to the accepted literature procedures. Flash column chromatography was carried out using Silica Gel 60 (Merck Kieselgel 230-400 mesh). Aluminium oxide (Brockmann activity 1, 0.05-0.15 mm, *p*H 7.0 ± 0.5) was from Fluka. Florisil® Adsorbent (60-100 mesh) was from Fluka. Melting points were determined on a Reichert hot stage apparatus and are uncorrected. Optical rotations were measured using a Perkin Elmer Model 343 polarimeter. ^{1}H NMR spectra were recorded at room temperature on Bruker DPX-400 (400 MHz), Bruker DPX-500 cryoprobe (500 MHz) and Bruker DRX-600 (600 MHz) instruments as dilute solutions in deuterated chloroform or deuterated benzene. The chemical shifts δ are reported in ppm relative to tetramethylsilane. Residual $CHCl_3$ (δ_H = 7.26 ppm) or C_6H_6 (δ_H = 7.15 ppm) was used as an internal standard. The multiplicity of the signals is designated by the following abbreviations: s, singlet; d, doublet; t, triplet; q, quartet; br, broad; m, multiplet. Coupling constants, *J*, are reported in Hertz (Hz). ^{13}C NMR spectra were recorded at 100 MHz or 125 MHz on Bruker DPX-400 and Bruker DPX-500 cryoprobe instruments, respectively. The spectra were recorded as dilute solutions in deuterated chloroform or deuterated benzene, with chemical shifts reported relative to the residual $CHCl_3$ (δ_C = 77.0 ppm, triplet) or C_6H_6 (δ_C = 128.6 ppm) as an internal standard. High resolution mass spectra were obtained on a Waters LCT Premier spectrometer with Micromass MS software using electrospray ionisation (ESI). Microanalyses were determined in the microanalytical laboratories at the Department of Chemistry, University of Cambridge using a CE-440 Elemental Analyser. X-ray crystal structures were determined on a Nonius Kappa CCD instrument at the Cambridge University Chemistry Laboratory X-Ray Laboratory.

While no special precautions were taken to exclude air or moisture from the reactions, it should be noted that $PtCl_4$ is hygroscopic and should be stored under argon.

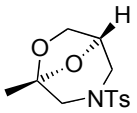
General procedure for the synthesis of fused bicyclic acetals 1 or 6.

A freshly prepared 0.01 M solution of $PtCl_4$ (0.02 equiv relative to alkyne **2**) in anhydrous THF was added to the substrate and the reaction mixture was stirred at room temperature until TLC analysis indicated complete conversion of the starting material. The solvent was removed by rotary evaporation and the crude product analysed by NMR spectroscopy. The bicyclic product was isolated after flash column chromatography (silica gel, petrol ether/ethyl acetate). The domino deprotection-cycloisomerisation reaction of BDA-protected alkyne diols was carried out as described above except that glacial acetic acid instead of THF was employed as solvent.



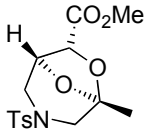
(1*S*,5*R*)-5-methyl-3-tosyl-6,8-dioxa-3-azabicyclo[3.2.1]octane (1a).

White crystalline solid. CCDC 662929. M.p. 134-136 °C. $[\alpha]_D^{25}$ = –36.0 ° ° cm^3 g^{-1} dm^{-1} (*c* = 1.83 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, C_6D_6): δ = 7.61 (2 H, d, *J* = 8.1 Hz), 6.81 (2 H, d, *J* = 8.1 Hz), 3.75 (2 H, m), 3.63 (1 H, d, *J* = 11.0 Hz), 3.42 (1 H, t, *J* = 6.1), 3.20 (1 H, dd, *J* = 11.5, 0.8), 2.47 (1 H, d, *J* = 11.5), 2.34 (1 H, d, *J* = 11.0), 1.92 (3 H, s), 1.19 (3 H, s). ^{13}C NMR (100 MHz, C_6D_6) δ = 143.2, 134.5, 129.7, 127.9, 104.3, 72.9, 68.2, 53.2, 48.1, 21.4, 21.1. HRMS (pos. ESI): *m/z* = 284.0970 $[M+H]^+$, $C_{13}H_{18}NO_4S$ requires 284.0957. Elemental analysis: Found C 56.42 H 6.55 N 4.32, $C_{13}H_{17}NO_4S$ requires C 55.11 H 6.05 N 4.95 %.



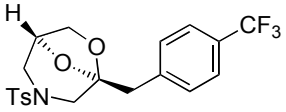
(1*R*,5*S*)-5-methyl-3-tosyl-6,8-dioxa-3-azabicyclo[3.2.1]octane (*ent*-1a).

White crystalline solid. M.p. $[\alpha]_D^{25}$ = +35.7 ° cm^3 g^{-1} dm^{-1} (*c* = 1.08 mg cm^{-3} in $CHCl_3$).



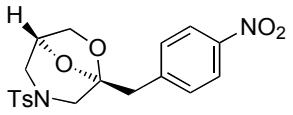
(1*S*,5*S*,7*R*)-methyl 5-methyl-3-tosyl-6,8-dioxa-3-azabicyclo[3.2.1]octane-7-carboxylate (1b).

Colourless viscous oil. $[\alpha]_D^{25}$ = –15.7 ° cm^3 g^{-1} dm^{-1} (*c* = 1.07 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.64 (2 H, d, *J* = 8.2 Hz), 7.33 (2 H, d, *J* = 8.2 Hz), 4.68 (2 H, d, *J* = 10.5 Hz), 3.76 (3 H, s), 3.65 (1 H, dd, *J* = 11.8, 0.9 Hz), 3.59 (1 H, d, *J* = 11.2 Hz), 2.82 (1 H, dd, *J* = 11.8, 1.9 Hz), 2.51 (1 H, d, *J* = 11.2 Hz), 2.44 (3 H, s), 1.54 (3 H, s). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 170.8, 144.1, 133.0, 129.8, 127.5, 106.5, 76.8, 76.6, 52.6, 52.1, 47.3, 21.5, 21.2 HRMS (pos. ESI): *m/z* = 342.1025 $[M+H]^+$, $C_{15}H_{20}NO_6S$ requires 342.1011.



(1*S*,5*R*)-3-tosyl-5-[4-(trifluoromethyl)benzyl]-6,8-dioxa-3-azabicyclo[3.2.1]octane (1j).

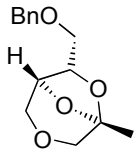
White crystalline solid. CCDC 662935. M.p. 118-120 °C. $[\alpha]_D^{25}$ = –27 ° cm^3 g^{-1} dm^{-1} (*c* = 1 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.61 (2 H, d, *J* = 8.2 Hz), 7.52 (2 H, d, *J* = 8.0 Hz), 7.35 (2 H, d, *J* = 8.0 Hz), 7.31 (2 H, d, *J* = 8.2 Hz), 4.51-4.48 (m, 1H), 4.00 (1 H, d, *J* = 6.9 Hz), 3.71 (1 H, ddd, *J* = 6.9, 6.5, 0.9 Hz), 3.54 (1 H, d, *J* = 11.0 Hz), 3.49 (1 H, dd, *J* = 11.3, 1.4 Hz), 3.09 (1 H, d, *J* = 14.3 Hz), 2.79 (1 H, d, *J* = 11.3 Hz), 2.50 (1 H, d, *J* = 11.0 Hz), 2.43 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 143.9, 138.4, 133.2, 130.7, 129.9 (m), 129.7, 129.4, 127.5, 125.0, 104.7, 72.7, 68.3, 51.8, 47.9, 40.7, 21.5. HRMS (pos. ESI): *m/z* = 428.1136 $[M+H]^+$, $C_{20}H_{22}F_3NO_4S$ requires 428.1143.



(1*S*,5*R*)-5-(4-nitrobenzyl)-3-tosyl-6,8-dioxa-3-azabicyclo[3.2.1]octane (1k).

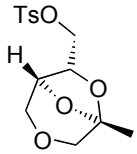
Yellow crystalline solid. CCDC 662938. M.p. 132-134 °C. $[\alpha]_D^{25}$ = –25 ° cm^3 g^{-1} dm^{-1} (*c* = 1.6 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.12 (2 H, d, *J* = 8.8 Hz), 7.61 (2 H, d, *J* = 8.4 Hz), 7.40 (2 H, d, *J* = 8.4 Hz), 7.32 (2 H, d, *J* = 8.1 Hz), 4.50 (1 H, m), 4.05 (1 H, d, *J* = 7.0 Hz), 3.65 (1 H, t, *J* = 6.0 Hz), 3.57 (1 H, d, *J* = 11.0 Hz), 3.51 (1 H, d, *J* = 11.0 Hz), 3.12 (1 H, d, *J* = 14.3 Hz), 3.08 (1 H, d, *J* = 14.3 Hz), 2.80 (1 H, d, *J* = 10.6 Hz), 2.53 (1 H, d, *J* = 11.0 Hz), 2.43 (3 H, s). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 147.5, 145.7, 144.4, 133.6, 131.7, 130.2, 127.9, 123.6, 105.0, 73.2, 68.8, 52.4, 48.4, 40.9, 21.9. HRMS (pos. ESI): *m/z* = 405.1124 $[M+H]^+$, $C_{19}H_{21}N_2O_6S$ requires 405.1120.

(1*S*,6*S*)-6-(4-nitrophenyl)-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6k).
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.18 (2 H, d, *J* = 8.8 Hz), 7.69 (2 H, d, *J* = 8.4 Hz), 7.64 (2 H, d, *J* = 8.8 Hz), 7.33 (2 H, d, *J* = 8.1 Hz), 4.68 (1 H, m), 4.26 (1 H, dd, *J* = 7.7, 1.5 Hz), 3.95 (1 H, t, *J* = 6.6 Hz), 3.75-3.82 (2 H, m), 2.97-3.10 (2 H, m), 2.45-2.55 (2 H, m), 2.44 (3H, s).



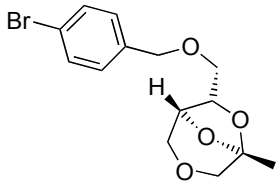
(1*S*,5*S*,7*S*)-7-(benzyloxymethyl)-5-methyl-3,6,8-trioxabicyclo[3.2.1]octane (1l).

Colourless oil. $[\alpha]_D^{25}$ = –15.8 ° cm^3 g^{-1} dm^{-1} (*c* = mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, C_6D_6): δ = 7.32-7.12 (m, *5*H), 4.70 (1 H, dd, *J* = 8.6, 4.8 Hz), 4.33 (s, 2H), 4.12 (s, 1H), 3.63 (1 H, d, *J* = 11.4 Hz), 3.55 (1 H, dd, *J* = 9.1, 4.8 Hz), 3.51 (1 H, d, *J* = 10.9 Hz), 3.41 (1 H, d, *J* = 9.1 Hz), 3.40 (1 H, d, *J* = 10.9 Hz), 3.30 (1 H, d, *J* = 11.4 Hz), 1.21 (s, 3H). ^{13}C NMR (100 MHz, C_6D_6): δ = 138.6, 128.4, 128.3, 128.1, 127.6, 127.5, 105.4, 77.1, 76.9, 73.1, 72.1, 71.4, 67.9, 19.7. HRMS (pos. ESI): *m/z* = 273.1103 $[M+Na]^+$, $C_{14}H_8O_4Na$ requires 273.1103.



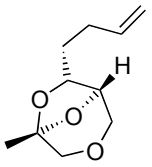
(1*S*,5*S*,7*S*)-5-methyl-3,6,8-trioxabicyclo[3.2.1]octan-7-yl)methyl 4-methylbenzenesulfonate (1m).

Colourless solid. $[\alpha]_D^{25}$ = –26.1 ° cm^3 g^{-1} dm^{-1} (*c* = 7.60 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.80 (2 H, d, *J* = 8.4 Hz), 7.35 (2 H, d, *J* = 8.1 Hz), 4.50 (1 H, dd, *J* = 8.2, 4.9 Hz), 4.23 (1 H, s), 3.96 (1 H, dd, *J* = 9.9, 4.76 Hz), 3.86 (1 H, dd, *J* = 9.9, 8.4 Hz), 3.81 (1 H, d, *J* = 11.7 Hz), 3.60 (1 H, dd, *J* = 11.3 Hz), 3.50 (1 H, dd, *J* = 11.3 Hz), 3.45 (1 H, dd, *J* = 11.3 Hz), 2.45 (3 H, s), 1.29 (3 H, s). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 145.1, 132.7, 130.0, 128.0, 106.3, 76.3, 75.4, 71.9, 69.1, 67.7, 21.6, 19.5. HRMS (pos. ESI): *m/z* = 315.0913 $[M+H]^+$, $C_{14}H_{19}O_6S$ requires 315.0902.



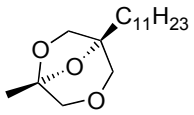
(1*S*,5*S*,7*S*)-7-[(4-bromobenzyloxy)methyl]-5-methyl-3,6,8-trioxabicyclo[3.2.1]octane (1n).

Colourless oil. $[\alpha]_D^{25}$ = –14.9 ° cm^3 g^{-1} dm^{-1} (*c* = 10.5 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.46 (2 H, d, *J* = 8.4 Hz), 7.20 (2 H, d, *J* = 8.4 Hz), 4.47-4.53 (1 H, m), 4.50 (2 H, s), 4.23 (1 H, s), 3.83 (1 H, d, *J* = 11.34 Hz), 3.62 (1 H, d, *J* = 11.34 Hz), 3.53 (1 H, d, *J* = 11.0 Hz), 3.50 (1 H, d, *J* = 10.2 Hz), 3.48 (1 H, d, *J* = 9.5 Hz), 3.36 (1 H, dd, *J* = 9.1, 8.1 Hz), 1.34 (3 H, s). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 137.4, 131.9, 12.7, 122.0, 106.0, 77.4, 77.1, 73.1, 72.6, 71.7, 68.5, 20.2. HRMS (pos. ESI): *m/z* = 329.0390 $[M+H]^+$, $C_{14}H_{18}O_4Br$ requires 329.0382.



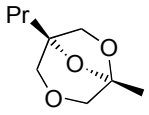
(1*R*,5*S*,7*R*)-7-(but-3-enyl)-5-methyl-3,6,8-trioxabicyclo[3.2.1]octane (*ent*-1o).

Colourless oil. $[\alpha]_D^{25}$ = +57.8 ° cm^3 g^{-1} dm^{-1} (*c* = 6.0 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 5.77-5.87 (1 H, m), 5.03 (1 H, d, *J* = 16.8 Hz), 4.97 (1 H, d, *J* = 10.2 Hz), 4.39 (1 H, t, *J* = 6.4 Hz), 4.03 (1 H, s), 3.80 (1 H, d, *J* = 11.7 Hz), 3.58 (1 H, d, *J* = 11.3 Hz), 3.52 (1 H, d, *J* = 11.0 Hz), 3.47 (1 H, d, *J* = 11.0 Hz), 2.06-2.21 (2 H, m), 1.56-1.71 (2 H, m), 1.35 (3 H, s). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 138.5, 115.3, 105.8, 78.7, 72.7, 68.5, 64.8, 48.8, 34.8, 29.9. HRMS (pos. ESI): *m/z* = 185.1165 $[M+H]^+$, $C_{10}H_{17}O_3$ requires 185.1172.



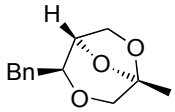
(1*R*,5*S*)-5-methyl-1-undecyl-3,6,8-trioxabicyclo[3.2.1]octane (*ent*-1p).

Colourless oil. $[\alpha]_D^{25}$ = +14 ° cm^3 g^{-1} dm^{-1} (*c* = 1 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 4.22 (1 H, d, *J* = 6.5 Hz), 3.65 (1 H, d, *J* = 11.0 Hz), 3.63 (1 H, d, *J* = 11.0 Hz), 3.58 (1 H dd, *J* = 6.5, 1.0 Hz), 3.54 (1 H, d, *J* = 10.9 Hz), 3.50 (1 H, d, *J* = 10.9 Hz), 1.40 (3 H, s), 1.38-1.22 (20 H, m), 0.90 (3 H, t, *J* = 7.0 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 105.5, 81.9, 72.2, 72.1, 71.8, 32.6, 31.8, 29.6, 29.5, 29.4, 23.5, 22.6, 19.6, 14.0. HRMS (pos. ESI): *m/z* = 307.2347 $[M+Na]^+$, $C_{17}H_{32}O_3Na$ requires 307.2243.



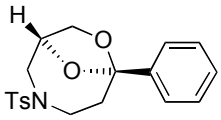
(1*S*,5*R*)-5-methyl-1-propyl-3,6,8-trioxabicyclo[3.2.1]octane (1q).

Colourless oil. $[\alpha]_D^{25}$ = –14.9 ° cm^3 g^{-1} dm^{-1} (*c* = 10.5 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 4.19 (1 H, d, *J* = 6.6 Hz), 3.61 (1 H, d, *J* = 11.2 Hz), 3.59 (1 H, d, *J* = 11.2 Hz), 3.55 (1 H, d, *J* = 6.6 Hz), 3.49 (1 H, d, *J* = 11.1 Hz), 3.46 (1 H, d, *J* = 11.1 Hz), 1.54-1.59 (2 H, m), 1.34 (3 H, s), 0.92 (3 H, t, *J* = 7.3 Hz), 0.81-0.88 (2 H, m). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 105.9, 82.3, 72.6, 72.5, 72.2, 35.2, 20.0, 17.3, 15.0. HRMS (pos. ESI): *m/z* = 195.0998 $[M+Na]^+$, $C_9H_{16}O_3Na$ requires 195.0991.



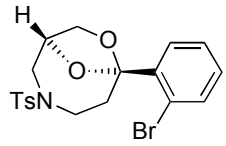
(1*R*,2*S*,5*R*)-2-benzyl-5-methyl-3,6,8-trioxabicyclo[3.2.1]octane (1r).

Colourless crystaline solid. CCDC 662933. M.p. 93 °C. $[\alpha]_D^{25}$ = –27.7 ° cm^3 g^{-1} dm^{-1} (*c* = 11.40 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.28-7.33 (2 H, m), 7.22-7.26 (1 H, m), 7.17-7.20 (2 H, m), 4.35 (1 H, d, *J* = 7.0 Hz), 4.22 (1 H, d, *J* = 5.1 Hz), 4.04 (1 H, t, *J* = 7.1 Hz), 3.84 (1 H, dd, *J* = 6.6, 5.5 Hz), 3.55 (2 H, s), 2.84 (1 H, dd, *J* = 14.1, 7.5 Hz), 2.60 (1 H, dd, *J* = 14.1, 7.1 Hz), 1.37 (3 H, s). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 136.8, 129.2, 128.6, 126.7, 104.5, 77.2, 76.6, 73.0, 65.0, 37.6, 19.0. Elemental analysis: Found C 70.81, H 7.38, $C_{19}H_{21}NO_4S$ requires C 70.89 H 7.32 %.



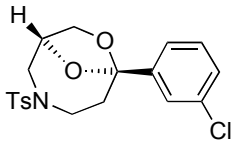
(1*S*,6*S*)-6-phenyl-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6c).

White crystalline solid. CCDC 662931. M.p. 155-158 °C. $[\alpha]_D^{25}$ = –80.8 ° cm^3 g^{-1} dm^{-1} (*c* = 5.25 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, C_6D_6): δ = 7.64 (2 H, d, *J* = 8.1 Hz), 7.67 (2 H, dd, *J* = 7.2, 1.3 Hz), 7.19-7.14 (2 H, m), 7.08 (1 H, t, *J* = 7.2 Hz), 6.85 (2 H, d, *J* = 8.1 Hz), 3.97 (1 H, dd, *J* = 7.4, 1.4 Hz), 3.91 (1 H, m), 3.58 (1 H, m), 3.52 (1 H, m), 3.36 (1 H, d, *J* = 13.3 Hz), 2.65 (1 H, ddd, *J* = 14.0, 11.0, 4.2 Hz), 2.59 (1 H, dd, *J* = 13.3, 2.2 Hz), 2.46 (1 H, m), 1.95 (3 H, s), 1.85 (1 H, ddd, *J* = 14.4, 4.1, 2.7 Hz). ^{13}C NMR (100 MHz, C_6D_6) δ 144.5, 142.8, 137.7, 129.7, 128.3, 128.0, 127.4, 125.0, 111.0, 76.6, 67.1, 54.0, 45.9, 43.4, 21.1 HRMS (pos. ESI): *m/z* = 360.1269 $[M+H]^+$, $C_{19}H_{22}NO_4S$ requires 360.1270. Elemental analysis: Found C 62.54, H 6.20, N 3.38, $C_{19}H_{21}NO_4S$ requires C 63.49 H 5.89 N 3.90 %.



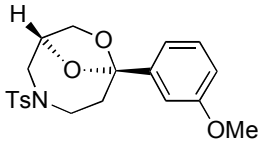
(1*S*,6*S*)-6-(2-bromophenyl)-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6d).

White crystalline solid. CCDC 662930. M.p. 145-146 °C. $[\alpha]_D^{25}$ = –53.8 ° cm^3 g^{-1} dm^{-1} (*c* = 8.83 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.79 (1 H, dd, *J* = 7.8, 1.7 Hz), 7.69 (2 H, d, *J* = 8.3 Hz), 7.58 (1 H, dd, *J* = 7.8, 0.8 Hz), 7.33 (2 H, d, *J* = 8.3 Hz), 7.28 (1 H, dt, *J* = 7.8, 0.8 Hz), 7.15 (1 H, dt, *J* = 7.8, 1.7 Hz), 4.63 (1 H, m), 4.28 (1 H, dd, *J* = 7.4, 1.6 Hz), 3.97 (1 H, m), 3.83 (1 H, m), 3.80 (1 H, m), 3.07 (1H, ddd, *J* = 14.2, 11.6, 4.1 Hz), 3.01 (1 H, dd, *J* = 13.4, 1.2 Hz), 2.50 (1 H, m), 2.44 (1 H, m), 2.44 (3 H, s). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 143.3, 141.8, 136.3, 134.4, 129.8, 129.6, 127.1, 126.9, 120.3, 110.4, 77.0, 65.9, 53.5, 46.1(CH_2-3), 41.8, 21.5. HRMS (pos. ESI): *m/z* = 460.0201 $[M+Na]^+$, $C_{19}H_{20}NO_4NaSBr$ requires 460.0194. Elemental anaysis: Found C 52.52 H 4.77 N 3.00, $C_{19}H_{20}NO_4SBr$ requires C 52.06 H 4.60 N 3.20 %.



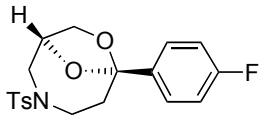
(1*S*,6*S*)-6-(3-chlorophenyl)-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6e).

White solid. M.p. 94-96 °C. $[\alpha]_D^{25}$ = –71.0 ° cm^3 g^{-1} dm^{-1} (*c* = 8.36 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.62 (2 H, d, *J* = 8.1 Hz), 7.40 (1 H, d, *J* = 0.8 Hz), 7.26 (2 H, d, *J* = 8.1 Hz), 7.21-7.17 (3 H, m), 4.57 (1 H, m), 4.15 (1 H, dd, *J* = 7.5, 1.4 Hz), 3.89 (1 H, m), 3.69 (2 H, m), 3.01 (1 H, dd, *J* = 13.5, 1.9 Hz), 2.93 (1 H, ddd, *J* = 14.3, 11.0, 4.3 Hz), 2.38 (1 H, m), 2.37 (3 H, s), 2.00 (1 H, ddd, *J* = 14.6, 4.2, 2.5 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 145.4, 143.4, 136.4, 134.1, 129.8, 129.6, 128.1, 126.9, 124.9, 122.8, 110.1, 76.7, 67.1, 53.9, 45.7, 42.7, 21.5. HRMS (pos. ESI): *m/z* = 394.0870 $[M+H]^+$, $C_{19}H_{21}NO_4SCl$ requires 394.0880.



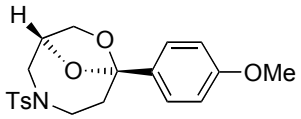
(1*S*,6*S*)-6-(3-methoxyphenyl)-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6f).

White solid. M.p. 86-88 °C. $[\alpha]_D^{25}$ = –70.8 ° cm^3 g^{-1} dm^{-1} (*c* = 3.5 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (500 MHz, C_6D_6): δ = 7.68 (2 H, d, *J* = 8.3 Hz), 7.37 (1 H, dd, *J* = 2.5, 1.7 Hz), 7.29 (1 H, ddd, *J* = 7.7, 1.6, 1.0 Hz), 7.18 (1 H, dd, *J* = 8.1, 7.8 Hz), 6.86 (2 H, d, *J* = 8.3 Hz), 6.79 (1 H, ddd, *J* = 8.2, 2.6, 0.9 Hz), 4.02 (1 H, dd, *J* = 7.4, 1.5 Hz), 3.93 (1 H, m), 3.63 (1 H, m), 3.58 (1 H, m), 3.39 (1 H, m), 3.38 (3H, s), 2.67 (1 H, ddd, *J* = 13.9, 11.1, 4.1 Hz), 2.60 (1 H, dd, *J* = 12.8, 2.5 Hz), 2.55 (1H, m), 1.97 (3H, s), 1.93 (1 H, ddd, *J* = 14.7, 4.2, 2.8 Hz). ^{13}C NMR (125 MHz, C_6D_6): δ = 160.1, 146.2, 142.7, 137.7, 129.7, 129.4, 127.3, 117.4, 113.6, 110.9, 110.8, 76.6, 67.0, 54.8 (OCH_3-17), 53.9, 45.9, 43.4, 21.1. HRMS (pos. ESI): *m/z* = 412.1187 $[M+Na]^+$, $C_{20}H_{23}NO_5NaS$ requires 412.1195.



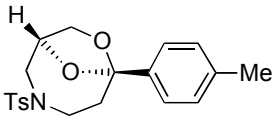
(1*S*,6*S*)-6-(4-fluorophenyl)-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6g).

White solid. CCDC 662932. M.p. 150-153 °C. $[\alpha]_D^{25}$ = –68.6 ° cm^3 g^{-1} dm^{-1} (*c* = 10 mg cm^{-3} in $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$): δ = 7.58 (2 H, d, *J* = 7.9 Hz), 7.34 (2 H, dd, *J* = 8.5, 5.5 Hz), 7.21 (2 H, d, *J* = 7.9 Hz), 6.89 (2 H, t, *J* = 8.5 Hz), 4.53 (1 H, m), 4.11 (1 H, d, *J* = 7.3 Hz), 3.85 (1H, m), 3.67 (1 H, m), 3.63 (1 H, m), 2.95 (1 H, d, *J* = 13.5 Hz), 2.88 (1 H, ddd, *J* = 14.3, 11.3, 4.2 Hz), 2.37 (1 H, m), 2.32 (3 H, s), 1.98 (1 H, d, *J* = 14.4 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 162.4 (d, *J* = 246 Hz), 143.3, 139.4 (d, *J* = 3 Hz), 136.3, 129.7, 126.9, 126.3 (d, *J* = 8 Hz), 114.9 (d, *J* = 21 Hz), 110.4, 76.6, 67.0, 53.8, 45.7, 42.8, 21.4. HRMS (pos ESI): *m/z* = 378.1189 $[M+H]^+$, $C_{19}H_{21}NO_4FS$ requires 378.1175. Elemental analysis: Found C 60.44, H 5.39, N 3.55, $C_{19}H_{21}NO_4FS$ requires C 60.46, H 5.34, N 3.71 %.



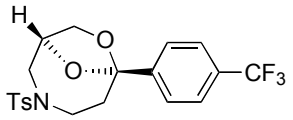
(1*S*,6*S*)-6-(4-methoxyphenyl)-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6h).

Colourless crystalline solid. CCDC 662934. M.p. 165-167 °C. $[\alpha]_D^{25}$ = –78.8 ° cm^3 g^{-1} dm^{-1} (*c* = 10.4 mg cm^{-3} in $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$): δ = 7.69 (2 H, d, *J* = 8.1 Hz), 7.40 (2 H, d, *J* = 8.7 Hz), 7.32 (2 H, d, *J* = 8.1 Hz), 6.85 (2 H, d, *J* = 8.7 Hz), 4.62 (1 H, m), 4.20 (1 H, d, *J* = 7.3 Hz), 3.97 (1 H, m), 3.79 (3 H, s), 3.77-3.72 (2 H, m), 3.06 (1 H, dd, *J* = 13.3, 1.5 Hz), 2.99 (1 H, ddd, *J* = 14.1, 11.1, 4.1 Hz), 2.47 (1 H, m), 2.43 (3 H, s), 2.14 (1 H, ddd, *J* = 14.5, 3.7, 2.6 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 159.2, 143.3, 136.2, 135.7, 129.7, 126.8, 125.7, 113.4, 110.6, 76.3, 66.9, 55.2, 53.8, 45.7, 42.6, 21.4. HRMS (pos. ESI): *m/z* = 390.1366 $[M+H]^+$, $C_{20}H_{24}NO_5S$ requires 390.1375. Elemental analysis: Found C 61.36, H 5.88, N 3.46, $C_{20}H_{23}NO_5S$ requires C 61.68, H 5.95, N 3.60 %.



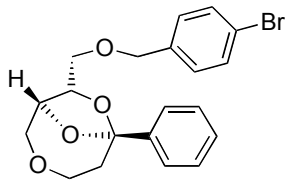
(1*S*,6*S*)-6-*p*-tolyl-3-tosyl-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6i).

Colourless crystalline solid. CCDC 662937. M.p. 167 °C. $[\alpha]_D^{25}$ = –76.3 ° cm^3 g^{-1} dm^{-1} (*c* = 9.87 mg cm^{-3} in $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$): δ = 7.69 (2 H, d, *J* = 8.8 Hz), 7.36 (2 H, d, *J* = 8.1 Hz), 7.32 (2 H, d, *J* = 8.1 Hz), 7.14 (2 H, d, *J* = 7.7 Hz), 4.62-4.63 (1 H, m), 4.21 (1 H, dd, *J* = 7.3, 1.5 Hz), 3.98 (1 H, t, *J* = 6.6 Hz), 3.76 (2 H, d, *J* = 13.5 Hz), 3.07 (1 H, dd, *J* = 13.4, 2.0 Hz), 3.00 (1 H, ddd, *J* = 14.6, 11.0, 4.0 Hz), 2.45-2.51 (1 H, m), 2.44 (3 H, s), 2.33 (3 H, s), 2.11-2.17 (1 H, m). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 143.3, 140.5, 137.7, 136.4, 129.8, 128.8, 127.0, 124.4, 110.8, 76.4, 66.9, 53.9, 45.8, 42.7, 21.5, 21.1. HRMS (pos. ESI): *m/z* = 374.1421 $[M+H]^+$, $C_{19}H_{22}NO_4FS$ requires 374.1420.



(1*S*,6*S*)-3-tosyl-6-[4-(trifluoromethyl)phenyl]-7,9-dioxa-3-azabicyclo[4.2.1]nonane (6j).

Colourless crystalline solid. CCDC 662936. M.p. 112-114 °C. $[\alpha]_D^{25}$ = –42 ° cm^3 g^{-1} dm^{-1} (*c* = 1.6 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.69 (2 H, d, *J* = 8.4 Hz), 7.59 (4 H, m), 7.32 (2 H, d, *J* = 8.4 Hz), 4.67-4.64 (1 H, m), 3.95 (1 H, ddd, *J* = 7.4, 6.2, 1.1 Hz), 3.81-3.74 (2 H, m), 3.08 (1 H, ddd, *J* = 13.5, 2.7, 1.0 Hz), 3.00 (1 H, ddd, *J* = 14.4, 11.1, 4.3 Hz), 2.49 (1 H, ddd, *J* = 11.6, 11.2, 5.6 Hz), 2.44 (3 H, s), 2.08 (1 H, ddd, *J* = 14.4, 4.4, 2.3 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 147.1, 143.4, 136.3, 129.8, 126.9, 126.8, 125.2 (m), 125.1, 124.9, 110.2, 77.7, 67.0, 53.8, 45.7, 42.7, 21.4. HRMS (pos. ESI): *m/z* = 428.1127 $[M+H]^+$, $C_{20}H_{22}F_3NO_4S$ requires 428.1127. Elemental analysis: Found C 56.60, H 4.83, N 3.06, $C_{20}H_{22}F_3NO_4S$ requires C 56.20, H 4.72, N 3.28 %.

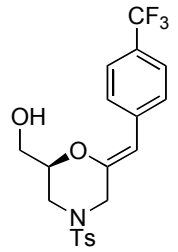


(1*S*,6*R*,8*S*)-8-[(4-bromobenzyloxy)methyl]-6-phenyl-3,7,9-trioxabicyclo[4.2.1]nonane (6s).

Brown oil. $[\alpha]_D^{25}$ = –27.2 ° cm^3 g^{-1} dm^{-1} (*c* = 10.50 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.75 (2 H, d, *J* = 8.4 Hz), 7.17-7.35 (5 H, m), 6.81 (2 H, d, *J* = 8.4 Hz), 4.52 (1 H, ddd, *J* = 7.4, 5.2, 2.1 Hz), 4.30 (1 H, s), 4.02 (2 H, s), 3.84 (1 H, ddd, *J* = 12.5, 5.9, 1.9 Hz), 3.58-3.67 (3 H, m), 3.35 (1 H, dd, *J* = 9.5, 5.1 Hz), 3.18 (1 H, dd, *J* = 9.5, 7.7 Hz), 2.56 (1 H, ddd, *J* = 15.0, 11.3, 5.9 Hz), 1.96 (1 H, ddd, *J* = 14.8, 3.8, 2.0 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 144.8, 137.4, 131.4, 129.0, 128.1, 127.7, 124.7, 121.4, 111.2, 81.2, 76.2, 74.6, 72.1, 71.4, 68.0, 45.5. HRMS (pos. ESI): *m/z* = 405.0721 $[M+H]^+$, $C_{20}H_{22}O_4Br$ requires 405.0701.

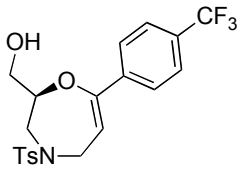
Synthesis of the enol ethers 7j and 9j.

A freshly prepared 0.01 M solution of $PtCl_4$ (0.02 equiv relative to alkyne **2**) in anhydrous THF was added to the substrate and the reaction mixture was stirred at room temperature for 3 hours (TLC analysis indicated complete conversion of the starting material). The solvent was removed by rotary evaporation and the crude product analysed by NMR spectroscopy. The enol ethers were isolated after flash column chromatography (Florisil® Adsorbent, petrol ether/ethyl acetate).



(*S*,*Z*)-{4-tosyl-6-[4-(trifluoromethyl)benzylidene]morpholin-2-yl}methanol (7j).

Colourless oil. $[\alpha]_D^{25}$ = +6.9 ° cm^3 g^{-1} dm^{-1} (*c* = 6.37 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (500 MHz, C_6D_6): δ = 7.59 (2 H, d, *J* = 8.4 Hz), 7.42 (2 H, d, *J* = 8.9 Hz), 7.40 (2 H, d, *J* = 8.9 Hz), 6.78 (2 H, d, *J* = 8.4 Hz), 5.07 (1 H, s), 3.73 (1 H, d, *J* = 6.1 Hz), 3.53 (1 H, m), 3.35 (1 H, dd, *J* = 12.2, 2.4 Hz), 3.21 (1 H, dd, *J* = 12.0, 4.8 Hz), 3.16-3.14 (2 H, m), 2.63 (1 H, dd, *J* = 12.2, 9.1 Hz), 1.89 (3 H, s). ^{13}C NMR (125 MHz, C_6D_6): δ = 148.4, 143.8, 133.0, 130.1-125.4, 108.6, 76.6, 62.4, 48.1, 46.2, 21.1. HRMS (pos. ESI): *m/z* = 428.1161 $[M+H]^+$, $C_{20}H_{21}NO_4F_3S$ requires 428.1143.



(*Z*)-{4-tosyl-7-[4-(trifluoromethyl)phenyl]-2,3,4,5-tetrahydro-1,4-oxazepin-2-yl}methanol (8j).

Colourless oil. $[\alpha]_D^{25}$ = +18.4 ° cm^3 g^{-1} dm^{-1} (*c* = 9.27 mg cm^{-3} in $CHCl_3$). ^{1}H NMR (400 MHz, C_6D_6): δ = 7.66 (2 H, d, *J* = 8.1 Hz), 7.29 (2 H, d, *J* = 8.4 Hz), 7.18 (2 H, d, *J* = 8.4 Hz), 6.70 (2 H, d, *J* = 8.1 Hz), 5.03 (1 H, t, *J* = 5.7 Hz), 3.71 (3 H, m), 3.44 (1 H, dd, *J* = 13.6, 2.3 Hz), 3.33 (1 H, dd, *J* = 13.6, 10.0 Hz), 3.25 (2 H, m), 1.79 (3 H, s), 1.29 (1 H, br s). ^{13}C NMR (100 MHz, C_6D_6): δ = 156.1, 142.8, 139.3 (d, *J* = 1.3), 136.6, 129.3-123.3, 104.5, 81.1, 62.8, 51.5, 44.4, 20.9. HRMS (pos. ESI): *m/z* = 428.1155 $[M+H]^+$, $C_{20}H_{21}NO_4F_3S$ requires 428.1143.